GE SIT 6.11

3.2

FINAL CLEANUP ACTION PLAN

FORMER GENERAL ELECTRIC SPOKANE SHOP

E. 4323 MISSION AVENUE

SPOKANE, WA

Washington State Department of Ecology

Toxics Cleanup Program

103 pgs

EXECUTIVE SUMMARY

General Electric Company constructed a service shop at E. 4323 Mission Avenue, Spokane, WA in 1961. The business of the facility was repair of electrical equipment, including transformers. During the course of operations of the facility, transformers were cleaned and repaired on site. Areas were established for storage of transformers and oils; wash waters were discharged to several underground dry wells and sumps on the property.

On October 15, 1985, a Site Inspection was conducted by Ecology, along with representatives of GE and Bechtel National Inc. (now Bechtel). Seven samples were collected from the service shop dry wells and surface soils adjacent to the building. These samples were analyzed for polychlorinated biphenyls (PCBs) and priority pollutant metals. Most samples indicated elevated levels of PCBs. The highest concentrations of PCBs were found in the vicinity of the southwest transformer storage area and in the west dry well.

The Environmental Protection Agency listed this site on the National Priorities List in October, 1989.

Since 1985, five phases of remedial investigation have been conducted at the facility. These investigations outlined PCB contamination in soil and ground water in concentrations which may threaten human health and the environment. Actions were taken during phase IV to limit immediate human exposure to PCBs, and to remove structures and localized contamination.

The following actions are planned to clean up the remaining PCBs at the site and mitigate the long term risk to human health and the environment:

1. Vitrification of Soils

Vitrification will be employed to treat on site soils. Shallow soils will be excavated, treated by screening to segregate large cobbles, and stockpiled within the area of contamination. Deep soils containing chemicals above cleanup levels will be treated with in-situ vitrification techniques. Stockpiled soil for treatment will be backfilled on top of the lower melt and vitrified.

Institutional Controls and Monitoring of Ground Water and Soil

Institutional controls when the cleanup action results in residual concentrations of hazardous substances that exceed cleanup levels. WAC 173-340-745 requires institutional controls on sites where cleanup levels have been set using industrial soil assumptions. At this site, institutional controls include restrictive covenants on extraction and use of ground water. These covenants shall be placed on the deeds of properties where ground water is impacted. In addition, restrictions and notices governing handling and disposal of site soils shall be placed on the deeds of affected properties.

Compliance Monitoring

Long term monitoring of ground water will be done to monitor the effectiveness of vitrification and reducing the threat to ground water, and to monitor any migration of PCBs off the subject site. Soil sampling will be conducted to document the performance of vitrification.

Should vitrification prove infeasible, Ecology proposes a contingent remedy for soils remediation. Dechlorination of shallow soils will destroy PCBs, and any PCBs which may impact ground water will be immobilized by grouting.

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LIST OF ACRONYMS

ARAR	Applicable or Relavent and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act, aka Superfund
CFR	Code of Federal Regulations
DCAP	Draft Cleanup Action Plan
EPA	U. S. Environmental Protection Agency
FCAP	Final Cleanup Action Plan
FS	Feasibility Study
GE	The General Electric Company
HEAST	Health Effects Assessment Summary Tables (EPA, 1990)
IRIS	Integrated Risk Information System (EPA, 1991)
ISV	In-Situ Vitrification
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram, or parts per million
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
PCB	Polychlorinated Biphenyls
PLP	Potentially Liable Persons
POTW	Publically Owned Treatment Works
ppm	Parts per million
PQL	Practical Quantitation Limit
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI/IA	Remedial Investigation/Interim Action
SARA	Superfund Amendments and Reauthorization Act
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
ug/l	Micrograms per liter, or parts per billion
VOC	Volatile Organic Compounds
WAC	Washington Administrative Code

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INTRODUCTION

PURPOSE

This decision document presents the selected cleanup action for the Former General Electric (GE) Facility, Spokane, WA, also known as the GE/Spokane site. The site is located at East 4323 Mission Avenue, Spokane, WA (Figure 1). The selection is based upon remedial investigations and feasibility studies conducted for GE, a potentially liable person (PLP) by Golder Associates, Bechtel Environmental, and other relevant information in Ecology's files.

This plan will briefly describe: (1) the site history; (2) the nature and extent of present contamination through summarizing the Remedial Investigation and Interim Action Reports (RI/IA); (3) the alternatives for Remedial Action at the facility presented in the Combined Feasibility Study (FS); (4) the proposed alternative; and (5) the remedial action objectives (RAO's). This plan was subject to public review and comment on proposed Site remediation.

DECLARATION

Ecology has selected this remedy because it will be protective of human health and the environment. Furthermore, the selected remedy is consistent with the preference of the State of Washington as stated in RCW 70.105D.030(1)(b) for permanent solutions.

APPLICABILITY

This Cleanup Action Plan is applicable only to the GE Spokane Site. Cleanup levels, hot-spot action levels, and cleanup actions have been developed as an overall remediation process being conducted under Ecology oversight using MTCA authority, and should not be considered as setting precedents for other sites.

Numerical values for cleanup levels are set by considering many site-specific factors, including: continuing Ecology involvement in this effort through the RI/FS process; that cleanup actions will be conducted under Ecology oversight; that a compliance monitoring plan will be implemented under Ecology oversight, and that remedial actions will be implemented under a consent decree entered into by Ecology and General Electric.

ADMINISTRATIVE RECORD

The documents used to make the decisions discussed in this cleanup action plan are constituents of the administrative record for the site. These documents are listed the Reference section.

The administrative record for the site is available for public review at the information repository for the site. That is located at Ecology's Eastern Regional Office, N. 4601 Monroe, Spokane, WA 99205-1295.

SITE HISTORY

FACILITY OPERATIONS

GE constructed a service shop on the site in 1961. The business of the facility was repair of electrical equipment, including transformers. Various structures existed on site, prior to interim action (Figure 3).

The Service Shop itself was of tilt-up construction, consisting of precast concrete, light steel, wood, and concrete masonry, and covered approximately 11000 square feet. Asphalt areas to the south and east, and an outdoor steam cleaning area were part of the original construction. A roof was added over the steam cleaning area in 1962, and in 1967 this area was enclosed. Also in 1967, the compressor and transformer storage rooms were added. An addition and sump (the North Sump) were added in 1971.

Transformers were stored outside the building, on gravel areas to the south, north, and west of the Service Shop. They were transferred into the building and steam cleaned. Steam cleaning wastes were discharged to the West Dry Well and the North Sump. Transformer oils were discharged to an above-ground storage tank in the North Warehouse. New transformer oils were stored in the Large Underground Oil Storage tank in the west end of the Service Shop. Machine shop activities took place in the southern portion of the shop, drained by the South Dry Well.

The North Warehouse was leased by GE from 1975 until 1980 from Mr. Marvin Riley. GE used the east end of this building for servicing electrical equipment, and the west end for the manufacture of motor coils. The East end of this warehouse contained two below-grade sumps (S5 and S6) draining into Dry Well S7. Two additional dry wells taking septic waste and floor drain effluent served this warehouse.

METHODS OF INVESTIGATION

Data were collected on behalf of General Electric Company to assess the hydrogeologic setting and environmental conditions on and in the vicinity of the site. The study area is shown in figure 1.

Data were obtained by reviewing past reports concerning the region, drilling borings, installing monitoring wells, excavating test pits and underground features, and sampling environmental media: soil, air, and ground water.

The environmental media were chemically analyzed for a wide range of chemicals.

The data were evaluated and comprehensive reports written. Those reports include the Phase I, II, and IV RI reports concerning soils (Bechtel, 1986; 1987; 1991) and the Phase III and V RI reports concerning ground water (Golder and Assoc., 1988; 1992). A baseline risk assessment was prepared describing the risks posed by the chemicals found at the site (Everest, 1992). A feasibility study was prepared evaluating feasible alternatives for the site (Bechtel, 1992)

Additional data were gathered regarding chemicals in ground water by Ecology and Environment (E&E, 1992) under contract to Ecology.

ENVIRONMENTAL STUDIES

On October 15, 1985, a Site Inspection was conducted by Ecology, along with representatives of GE and Bechtel National Inc. (now Bechtel). Seven samples were collected from the service shop dry wells and surface soils adjacent to the building. These samples were analyzed for polychlorinated biphenyls (PCBs) and priority pollutant metals. Most samples indicated elevated levels of PCBs. The highest concentrations of PCBs were found in the vicinity of the southwest transformer storage area and in the west dry well. Copper, lead and zinc were found in the west dry well and in the south floor pit areas.

Bechtel conducted a study in the summer of 1986, including both surface and subsurface sampling. This Phase I Remedial Investigation included sampling of the former service shop area, the Riley property, and adjacent Washington Water Power (WWP) land. Results indicated PCB contamination of soils at levels between 1 to 100 parts per million (ppm) in surface samples taken in areas where transformers had been stored. Higher levels of PCBs were associated with some dry wells and sumps, especially the west dry well area. Surface contamination was shown to extend only to very shallow depths.

Additional sampling in 1986 evaluated potential contamination of walls, foundations, and sump sludges. Low to moderate levels of PCB's were found on concrete surfaces and in sump sludges.

Phase 2 sampling began in late 1986. The study evaluated preliminary groundwater characteristics, and further characterized soil and structure contamination. Five groundwater wells were installed, and sampled for PCB's and Volatile Organic Compounds (VOC's). Results indicated contamination of wells with VOC's and PCB's in well MW5, in the immediate vicinity of the west dry well.

Substantial contamination of the building, especially in the steam cleaning area, was demonstrated. Soil contamination was further defined.

Phase 3 Remedial Investigation activities included installing seven additional exploratory borings, six of which were later developed into monitoring wells. VOC contamination of groundwater was suggested to be minimal, and PCB and chlorinated benzene contamination was found in new wells at low concentrations.

The Phase 4 Remedial Investigation (June through August, 1990) defined the extent of contamination for all constituents previously found on the site. Samples were analyzed for chlorinated benzenes, priority pollutant metals, PCB's, VOC's, and petroleum hydrocarbons. This work also defined the extent of drainage structures (dry wells, sumps, etc.) on the site, with the exception of the West Dry Well, the Unknown Sump, and dry well DW8. The structures were excavated during Interim Action activities (see below). The current extent of soil contamination on site is shown in figure 4.

Phase 5 activities were restricted to groundwater. Six additional downgradient wells were installed to facilitate delineation of any dissolved plume of constituents. Ecology split samples with GE's consultant during the quarterly sampling of site wells, in an effort to demonstrate the ability of analytical methods to show compliance with current PCB cleanup levels in groundwater (Ecology and Environment, 1992). The study illustrated a low level PCB plume (figure 6) restricted to groundwater on site, in general in the immediate vicinity of the West Dry Well.

INTERIM ACTIONS

Interim action was undertaken on site in 1989 to facilitate access to portions of the site for further characterization of site soil and debris. Additionally, it provided material for a demonstration of in-situ vitrification (ISV) technology.

The Service Shop building was demolished and removed. The foundation and adjacent concrete and asphalt paving were removed and transported for disposal. Portions of the North Warehouse concrete floor and exterior slab were demolished. All debris was managed and disposed as chemically contaminated material.

As previously stated, all known underground drainage and liquid management structures were removed, with the exception of the West Dry Well, the Unknown Sump, and Dry Well DW8. Some 2,800 tons of PCB-containing debris from demolition was disposed of at the Arlington, Oregon RCRA/TSCA-permitted disposal facility.

Most shallow soils containing PCB's, VOC's, and metals were excavated during interim action and ISV Demonstration Test Preparation activities. Shallow soil is defined at this site are those soils less than 15 feet deep. PCB contamination extends below 3 feet only in the vicinity of the West Dry Well and the Transformer Oil Storage tank.

Additionally, equipment belonging to Mr. Marvin Riley was cleaned and relocated, and the site was fenced.

In an effort to secure cobbles for the ISV Test Cell Construction, on site soils which were believed to be uncontaminated were screened. Materials produced from this effort were backfilled at locations on the site (Figure 7). Later confirmation sampling suggested these fines did indeed contain PCB's at concentrations greater than 10 mg/kg, so clean gravel was imported and used to cover large portions of the site. This cover was placed to eliminate direct contact pathways to site workers and wind transport of material off site.

ISV DEMONSTRATION TEST

Under Agreed Order 90-05, General Electric Company agreed to perform a test of ISV technology for demonstration of TSCA permit. ISV technology is a thermal treatment/immobilization process whereby electrical heating converts chemical bearing soils to chemically inert glass or crystalline material. During the process, electrodes heat soils to temperatures in excess of 1600 degrees Celsius, causing melting of the geologic material, and vaporization and pyrolization of organic constituents to elemental gaseous components. Off gases are collected to remove residual chemicals and particulate matter.

A structure, containing 5 treatment cells, was constructed on the site during Interim Action activities. Chemical bearing site soils and debris were deposited into this structure for treatment. Currently, the technology is undergoing acceptance tests prior to being moved on site to perform the tests.

SUMMARY OF ENVIRONMENTAL ISSUES

SITE GEOLOGY

The site is located in the Spokane River Valley, which extends from Lake Coeur D'Alene in Western Idaho into eastern Washington. A thick deposit of unconsolidated sediments fills this valley. These deposits are generally fluvial and/or flood related gravels and sands, generally moderately to poorly sorted, with maximum grain sizes ranging from pebbles to boulders. These deposits overly bedrock of variable age. Depth to bedrock is highly variable, but generally exceeds 400 feet. Thin surface soils overly the gravels, and are generally fine grained.

The gravels host the Spokane Aquifer, a sole-source drinking water aquifer for the City of Spokane, and most of the population of the County.

NATURE AND EXTENT OF CHEMICAL RESIDUES

This discussion refers to chemical residues remaining after interim action activities which will be the subject of further remedial action. The chemical bearing material is in three places, or media. These three media are: Shallow soil, or those soils roughly 15 feet deep or less; Deep soil, those soils at greater than 15 feet deep, including the capillary fringe; and groundwater, or the uppermost aquifer below the site.

Shallow Soil

Figure 4 illustrates the current distribution of shallow soils containing greater than 10 mg/kg PCB's. Highest PCB values are localized in the West Dry Well and Large Transformer Oil Storage Tank. Other chemicals including VOCs and metals are associated with the PCBs.

The volume of shallow soils bearing PCB's at levels in excess of 10 mg/kg is roughly 6,150 cubic yards.

Deep Soil

Soils greater than 15 feet deep which host contamination are restricted to the West Dry Well and the Large Transformer Oil Storage Tank areas. VOC's, PCB's, metals, chlorinated benzenes, and petroleum hydrocarbons are associated in these areas.

The West Dry Well (Figure 5) has high chemical concentrations at the bottom of the dry well. These concentrations decrease in soils below the dry well. For example, PCBs range in concentration from greater than 20,000 mg/kg at the bottom of the dry well to tens of mg/kg in capillary fringe soils at the water table. Petroleum hydrocarbons range from 1000 mg/kg in the dry well to less than 100 mg/kg at the water table. Chlorinated benzenes range, in the same zone, from a high of 300 mg/kg to 0.002 mg/kg at the water table. VOC analyses generally follow the same trend.

Metals concentrations are similar, but do not exceed MTCA Method A Cleanup Levels (See Discussion of Cleanup Levels Below).

The Large Transformer Oil Storage Tank Area has PCB contaminated soils in the bottom of the backfilled excavation. Levels of contamination range from 100 to 250 mg/kg.

350 cubic yards of deep soil will require remediation.

CONTAMINANT TRANSPORT

Contaminant transport from the site is by one major mechanism: leaching of PCBs and associated chemicals to ground water. The rate at which this leaching and ground water transport occurs is dependent upon the sorption/desorption phenomena associated with PCBs in their interaction with site soil. PCBs in general, and those types present at the GE site specifically, have a high affinity for soil constituents. They also have a low solubility. Given these characteristics, the ultimate fate of PCBs at this site is sorption on aquifer materials. This fits the observed localization of chemical bearing ground water adjacent to the PCB source in the West Dry Well.

RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

The Baseline Risk Assessment (Everest, 1992) explored the potential risks to human health and the environment from the site. It considered the chemical constituents present, their characteristics, and concentrations, and evaluated them in light of local site characterisitics. The result is a description of the pathways for exposure to chemicals at the site.

No significant recreational or agricultural use is in the immediate area of the site. The site is located in an industrial area, and is zoned to remain industrial for the forseeable future. No known rare or endangered species are present in the vicinity. Given the chemical characteristics and cobble cover, little species or human exposure via air through volatilization or suspension is likely.

Exposure pathway analysis indicated that human exposure is likely under only 3 scenarios: ingestion of soil, dermal contact with soil, and ingestion of ground water. All these exposure pathways are considered future exposures, as interim actions or other site considerations have minimized current exposure.

Non-carcinogenic hazards from the site are below MTCA threshold criteria (See Cleanup Level discussion, below). Carcinogenic risks based upon the exposure scenarios exceed MTCA exposure limits.

CLEANUP STANDARDS

The objective of the cleanup standard development process is determining which hazardous substances contribute a large percentage of the overall threat to human health and the environment at the site ("indicator hazardous substances"); what concentration of those hazardous substances protect human health and the environment ("cleanup levels"); and, finally, the location on the site at which those cleanup levels must be obtained ("points of compliance").

Cleanup levels for individual hazardous substances are calculated based upon 3 separate methods under the MTCA. Method A is appropriate for routine sites or sites that involve relatively few hazardous substances. Method B is the standard method for determining cleanup levels and is applicable to all sites. Method C is a conditional method generally applicable where Method A or B may be impossible to achieve or may cause greater environmental harm. Cleanup level methods are available for all environmental "media": ground water, surface water, soil, and air.

Once cleanup levels have been established, all media having concentrations of chemicals above those levels must be addressed using one or more of the cleanup technologies outlined in WAC 173-340-360(4).

CLEANUP LEVEL METHODS

At the GE/Spokane site, Ecology has determined that two media have been contaminated, ground water and soil. Several contaminants of concern may exist. Method A standards are generally not applicable in this case.

The highest beneficial use of Site ground water is as a current or future drinking water source. Ecology has determined that exposure to hazardous substances through ingestion of drinking water and other domestic uses represent the reasonable maximum exposure expected [WAC 173-340-720(1)(a)]. Given this exposure scenario, Method B is the appropriate method for establishing final cleanup levels in ground water at the site. Method B cleanup levels for carcinogens are based upon the upper bound of the estimated excess lifetime cancer risk of one in one million (1×10^{-6}).

Method C is not applicable for ground water, because compliance with cleanup levels are achievable and potential applicable technologies will not cause greater environmental harm. Method C cleanup levels for carcinogens are based upon the upper bound of the estimated excess lifetime cancer risk of one in one hundred thousand (1×10^{-5}).

Ecology has determined that in soil, an industrial site use scenario represents the reasonable maximum exposure expected [WAC 173-340-745(1)(b)]. No Method B calculation is available for industrial soils; Method C for industrial soil will be used to calculate health based values.

INDICATOR HAZARDOUS SUBSTANCES

Selection of indicator substances may be appropriate at sites with multiple chemicals. A substance should be considered for regulation under MTCA if the maximum concentration of that substance is greater than its cleanup level calculated through the appropriate method formula, or if the maximum concentration exceeds levels found in relevant and appropriate requirements (ARAR's) [WAC 173-340-705(2)].

Not all substances in violation of a cleanup level are regulated. The following factors [WAC 173-340-708(2)(b)] are used to determine whether a substance is retained as an indicator parameter for analysis of overall site hazard or risk:

1. The concentration of the substance. Substances with concentrations marginally above their cleanup levels may not be important in considerations of overall hazard and risk.

2. The frequency of detection of the substance. It may be appropriate to eliminate compounds which are detected with a frequency of less than 5 percent.

3. The toxicity of the substance. It may be suitable to delete substances of low toxicity.

4. Environmental fate. Substances which readily degrade in the environment may not be of importance to overall hazard or risk. Conversely, those with highly toxic degradation products should be included in an analysis of overall hazard and risk.

5. The substance is present at high natural background concentrations. MTCA regulates risks due to substances found at contaminated waste sites. Risks caused by substances at background concentrations are not addressed by MTCA.

6. The mobility and potential for exposure to the substance. Substances may be eliminated if these parameters are low.

Limitations of analytical chemistry are also considered. The practical quantitation limit (PQL) for detection of a substance may be greater than its risk-based cleanup level. The risk-based cleanup level is used in the analysis of overall site hazard and risk in such cases, but the regulatory limit for that substance will be the PQL. Improvements in analytical technology will result in readjustment of the regulatory limit to match the new, lower PQL during any subsequent evaluation of the site.

Once a list of substances to be assessed for cumulative risks and hazards has been developed, total site risk is calculated based upon the established cleanup levels. Carcinogenic risks are summed in all media; the total cancer risk for a site may not exceed 1×10^{-5}. The Hazard Index, calculated for substances with similar non-carcinogenic toxic effects, are also summed across all media, and the final total may not exceed 1.

Ground Water Indicator Substances

Method Analysis

As previously noted, the highest beneficial use of site ground water is as a current or future drinking water source. Site ground water is in the Spokane Aquifer, a Sole Source drinking water aquifer. Exposure to hazardous substances through ingestion or domestic use of ground water is the pathway of concern. In these cases, WAC 173-340-720(3) ("Method B") is the appropriate method to develop ground water cleanup levels.

Ground water cleanup level development is completed first, as soil cleanup levels must be calculated at levels which will not violate the ground water standard.

Specific Substances

Of the chemicals detected in ground water (table 1), Method B health based standards are available for 11. Of these, tetrachloroethene, trichloroethane, xylenes, 1,2,3,5 tetrachlorobenzene, TPH, diethyl phthalate, lead, and zinc have been detected with maximum concentrations below Method B health based standards. These substances are not retained for analysis of site risk, and cleanup standards are not developed.

Benzene has a maximum concentration slightly above the MCL, detected in MW-9U on one sampling event. Other benzene analyses in wells closer to the West Dry Well are either below Method B health based levels or at levels below the detection limit. Benzene will not be retained for analysis of overall site risk.

Trichloroethene's frequency of detection represents 1 detection in five analyses. Data is not available to confirm or expand upon the existence of this substance in ground water. The maximum concentration of this substance in soils is below health based levels of concern, so this substance will not be retained for analysis of overall site risk.

Maximum concentrations of total PCBs consistently exceed both Federal Maximum Contaminant Level (MCL) values and Washington State health based criteria, and are retained for cleanup standard development and analysis of overall site risk.

Soil Indicator Hazardous Substances

Method Analysis

The most likely pathway for human exposure to chemicals at this site is through direct contact or ingestion of soils (Everest, 1992). Reasonable maximum exposure scenarios for the Site have established that human exposure via direct contact or ingestion will be in an industrial setting. WAC 173-340-745(1)(b) details the criteria for establishing industrial soil cleanup levels. The criteria are:

1. The site is zoned for industrial use;

2. The site is currently used for industrial purposes and has a history of use for industrial purposes;

3. Adjacent properties are currently used or designated for use for industrial purposes;

4. The site is expected to be used for industrial purposes for the foreseeable future due to zoning, regulatory or statutory restrictions, comprehensive plans, adjacent land use, or other reasons;

5. Institutional controls are available for use in the cleanup action.

Ecology has determined that the site meets all five of these criteria, thus the industrial soil reasonable maximum exposure scenario is valid.

Specific Substances

A review of chemicals present in site soils (Table 2) indicates that maximum concentrations exceed Method C health-based industrial soil cleanup levels for only two substances: PCBs and Beryllium.

Method A table values for industrial soil [WAC 173-340-745(2)] may be relevant and appropriate for substances or mixtures of substances at this site. These tabulated standards are conservative cleanup levels intended to apply to sites undergoing routine cleanup actions or for those sites with relaatively few hazardous substances. Several hazardous substances exceed Method A values at this Site, so they will be discussed below. Soil standards based on ground water protection (Method A industrial soil) are exceeded by Total Petroleum Hydrocarbons (TPH) and Cadmium, and Method A standards for direct contact are exceeded by Lead.

PCBs will be retained as indicator hazardous substances as concentrations are substantially above Method C standards. PCBs are the dominant risk-causing chemical at the site (Everest, 1992).

Beryllium was frequently detected (80%), but in only 2 samples (D5-10C and D5-20B) did the concentration exceed the health based standard of 1 mg/kg. These samples are in close proximity to the West Dry Well, and associated with high concentrations of PCBs. As the maximum concentration is marginally above the MTCA standard and spatially associated with the broader PCB contamination, beryllium is not retained for analysis of overall risk and a cleanup standard will not be established.

TPH is an indicator analysis, designed to quantify petroleum hydrocarbons originating from gasoline, kerosene, jet fuel, diesel, and lubricating oil spills. These products vary considerably in proportion of specific constituents. TPH reports the total of the specific constituents, without differentiating them. It is from those individual constituents that risk is associated with petroleum hydrocarbons.

Mineral oils, used in transformers and associated with PCBs, are highly refined saturated hydrocarbons. If present, they could be responsible for elevated TPH analysis. The TPH analysis alone cannot differentiate fuels from mineral oils.

No health risk information is available for TPH analysis, so a Method C health based value cannot be calculated. TPH will not be retained for analysis of overall risk.

Industrial Method A standards are available for TPH on the basis of ground water protection. The method A standard is conservative, that is it is likely to result in no leaching of the most soluble, mobile individual constituent. Site TPH analyses exceed the Method A standard by a large amount. A TPH level will be set based upon ground water protection at the method A value.

Cadmium has a relatively low frequency of detection (28%), and of those only 1 sample from the West Dry Well area, associated with high levels of PCBs (D2-7.4), exceeds standards based on ground water protection. Cadmium has not been detected in ground water. The maximum concentration is far below the Method C health based value. Cadmium will not be retained for analysis of overall site risk and a cleanup level will not be established.

Lead is detected in 100% of soil analyses. No reference dose has been adopted by IRIS or HEAST for lead toxicity. Only 6 samples (D1-7.4; NCT-030, -031, and -032; SOILS1-1(1), SLUDGES-8) exceeded Method A standards, and these samples are all spatially associated with high levels of PCBs. The Method A standard, included for reference only, is based upon preventing unacceptable blood lead levels in children. The industrial site exposure scenario is based on an adult population being exposed. As no reference dose is available, Method C values cannot be calculated. Lead will not be retained for analysis of overall site risk and a cleanup level will not be established.

Trichloroethylene exceeds Method A values based upon protection of ground water. It is detected only in 3.4% of samples, and thus can be removed from analysis as it may not contribute significantly to site risk. Its maximum concentration in deep soils is several orders of magnitude lower than Method C health based criteria.

CLEANUP STANDARD DEVELOPMENT

Total PCBs and TPH are the only substances in any media retained for development of cleanup standards. Table 5 summarizes the final cleanup standards for the GE/Spokane site.

Ground Water

Cleanup levels set under Method B for ground water are set at least as stringent as the following [WAC 173-340-720(3)(a)]:

i) Concentrations established under applicable state and federal laws, including the requirements in WAC 173-340-720(2)(a)(ii), which are:

(A) Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act and published in 40 CFR Part 141, as amended;

(B) Maximum contaminant level goals (MCLGs) for noncarcinogens established under the Safe Drinking Water Act and published in 40 CFR part 141, as amended;

(C) Secondary maximum contaminant levels established under the Safe Drinking Water Act, 40 CFR Part 141, as amended; and

(D) Maximum contaminant levels established by the state board of health and published in chapter 248-54 WAC, as amended.

ii) For hazardous substances for which sufficiently protective, health based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health as determined by the risk based equations of WAC 173-340-720(3)(a)(ii)(A) and (B) for non-carcinogenic and carcinogenic effects, respectively.

Values corresponding to these criteria are presented in table 3.

The most stringent of these values for PCBs are those calculated under the carcinogenic risk equation of WAC 173-340-720(3)(a)(ii)(B). The Federal MCL is not sufficiently protective. Site risk calculated using the Method B equation is 4.4×10^{-5} based upon this groundwater value alone. This risk exceeds the acceptable total site risk value of 1×10^{-5} [WAC 173-340-705(4)].

Total PCBs in ground water cannot be quantitated at the Method B health-based standard of 0.0114 ug/l. In these cases, WAC 173-340-707(2) allows the regulatory limit to be set at the PQL for the method of analysis, 0.1 ug/l. If the PQL is lowered during cleanup of the site or during periodic review, the regulatory limit will be adjusted downward to reflect the lowest achievable PQL [WAC 173-340-707(4)]. If no improvement in technology occurs, achieving the PQL shall be considered as achieving the actual cleanup level (WAC 173-340-707(2)].

Total site risk and soil cleanup levels will be calculated using the actual health based value.

Soil

Method C industrial soil cleanup levels are established at the most stringent level of the following [WAC 173-340-745(4)(a)]:

(i) Concentrations established under applicable state and federal laws;

(ii) Concentrations which will not cause contamination of ground water to exceed ground water cleanup levels established under WAC 173-340-720 as determined:

   (A) For individual hazardous substances or mixtures, concentrations that are equal to or less than one hundred times the ground water cleanup level established in accordance with WAC 173-340-720, unless it can be demonstrated that higher concentrations are protective of ground water at the site;

(iii) For those hazardous substances for which sufficiently protective health based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health and the environment as determined by the risk based equations of WAC 173-340-745(4)(a)(iii)(A) and (B) for non-carcinogenic and carcinogenic effects, respectively.

Values corresponding to these criteria are presented in table 4.

Soil cleanup levels based upon ground water protection criteria apply throughout the site, while those based upon human exposure via direct contact apply only from the ground surface to fifteen feet below ground surface [WAC 173-340-740(6)].

PCBs are regulated under state and federal law largely on storage, transport, and disposal bases. These rules generally apply only when contaminated materials are moved, thus, they become applicable when some action is taken. The most stringent value for these are the Washington State Dangerous Waste rules, which regulate PCB materials from transformers to a level of 1 part per million.

Applicable guidance for PCBs suggest an action level for materials contaminated with PCBs at industrial sites at between 10 ppm and 25 ppm (EPA, 1990).

Determination of levels protective of ground water requires modeling, unless the 100 times ground water method is chosen. Ecology has applied such a model at this site. The agency has determined that a 60 mg/kg PCB concentration in soil on the GE site is protective of ground water (Appendix A). They will apply throughout the site [WAC 173-340-740(6)(b)].

WAC 173-340-745(4)(a)(iii)(B) calculates a value for PCBs based upon assumptions of health risk from direct contact. This equation assumes an industrial site exposure scenario.

Shallow soils health-based cleanup level of 17 mg/kg has been adjusted downward to 10 mg/kg, taking into account relevant and appropriate guidance documents, and the total site risk cap of 1×10^{-5}. Institutional controls regarding handling and limiting industrial exposure will be necessary at this cleanup level [WAC 173-340-706(1)]. This cleanup level will apply from ground surface to 15 feet below ground surface [WAC 173-340-740(6)(c)].

FINAL CLEANUP STANDARDS

The final numerical cleanup levels are summarized in Table 5. For PCBs, 10 mg/kg will apply in surface soils, or those soils from ground surface to 15 feet below ground surface. PCB cleanup levels will be 60 mg/kg below that elevation. For Total Petroleum Hydrocarbons, the 200 mg/kg level will apply in all soils.

For ground water, the final cleanup level will be 0.1 ug/l, the PQL for the method of analysis. Total PCBs in ground water cannot be quantitated at the Method B health-based standard of 0.0114 ug/l. If the PQL is lowered during cleanup of the site or during periodic review, the regulatory limit will be adjusted downward to reflect the lowest achievable PQL [WAC 173-340-707(4)]. If no improvement in technology occurs, achieving the PQL shall be considered as achieving the actual cleanup level (WAC 173-340-707(2)]. This level must be achieved throughout the site from the uppermost level of the saturated zone vertically to the lowermost depth potentially affected by the site [WAC 173-340-720(6)(b)]. That lowermost level is, given the density of the hazardous substances, within 3 meters of the phreatic surface.

No parameters were retained for analysis based upon non-carcinogenic effects, so no hazard quotient is calculated. Non-carcinogenic effects of PCBs are less of a threat to human health and the environment than the carcinogenic effects. The site cancer risk calculated using these standards does not exceed the maximum acceptable site risk of 1×10^{-5}.

GE/SPOKANE CLEANUP ACTION

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are goals for protecting human health and the environment. They are developed considering the characteristics of the medium (e.g. soil, water, or air), the characteristics of the chemicals present, the migration and exposure pathways, and potential receptor points.

As previously discussed, there are three media of concern: ground water, deep soil, and shallow soils. PCBs represent the dominant risk to human health and the environment from the site, and they are of very low geochemical mobility. Human exposure from the site is due to inhalation, dermal contact, or ingestion of soil, and potential ingestion of ground water. Though no receptors lie in direct path from the GE/Spokane site in the ground water pathway, the status of the Spokane Aquifer as a Sole Source Drinking Water aquifer suggests exposure via this route is credible.

Based upon these anticipated exposure pathways, the following remedial action objectives have been developed for shallow and deep soils:

- Reduce the potential for migration of PCBs from soil to ground water as necessary to protect the quality of potential drinking water;
- Prevent dermal contact with or ingestion of soils which may have excess cancer risk levels of 6 $x10^{-6}$ or more associated with PCBs.

As previously discussed, chemical transport via ground water appears to be an important potential exposure pathway at the site. The following RAOs are consistent with that pathway:

- Prevent ingestion of chemical bearing ground water
- Prevent off site migration of chemical bearing ground water
- Protect beneficial uses of ground water

SUMMARY OF FEASIBILITY STUDY CLEANUP ACTION ALTERNATIVES

Introduction

In the Feasibility Study (Bechtel, 1992) eight alternatives for addressing soil contamination and five alternatives for addressing ground water contamination were evaluated. Each alternative was individually analyzed for compliance with criteria for cleanup actions under CERCLA.

In this document, the selection of cleanup action will be done in accordance with WAC 173-340-360, MTCA regulations governing the selection. This is consistent with the cleanup being performed under State authority.

The alternatives analyzed for soil were:

- No Action
- Institutional Controls and Capping
- Excavation, Screening, and Offsite Disposal of Shallow and Deep Soil
- Excavation, Screening, and Stabilization of Shallow Soil; In-Situ Stabilization of Deep Soil; Capping and Institutional Controls
- Excavation, Screening, and Solvent Extraction of Shallow Soil; In-Situ Stabilization of Deep Soil
- Excavation, Screening, and Dechlorination of Shallow Soils, In-Situ Stabilization of Deep Soil
- Excavation, Screening, and On-Site Incineration of Shallow and Deep Soil
- Excavation, Screening, and Vitrification of Shallow Soils; In-Situ Vitrification of Deep Soils

The ground water alternatives were:

- No Action
- Institutional Controls with Ground Water Monitoring
- Extraction with Filtration/Carbon Treatment and Discharge to POTW
- Extraction with UV-Oxidation Treatment and On-Site Injection
- Extraction with Discharge to POTW, No Pretreatment

Following this individual analysis, five actions, combining alternatives for both soil and ground water, were presented. They were combined acknowledging the potential impact of soil remedial actions upon ground water remedial alternatives, and the complimentary nature of several technologies. Of the five alternatives presented, one is a "no action" alternative, presented as a baseline for comparison with active site remediation. The other four consider either off-site disposal or on-site treatment of soil, and either active extraction and treatment or institutional controls for groundwater protection.

Because soil cleanup levels are developed using industrial criteria, all soil alternatives will require institutional controls to limit access to the property and guide future uses. All active soil remediation methods involve screening of the soil to remove cobbles. As previously discussed, large cobbles are generally not significantly contaminated, or only contaminated on their surfaces, which are easily remediated through washing.

Cleanup Action Alternatives

Combined Alternative 1 -

No Action

The No Action alternative does not require any remedial activity. No action, other than maintenance of the current fence would take place. The site would continue in its current state.

Combined Alternative 2 -

Off-site Disposal of Soil, and Institutional Controls on Ground Water Use

Under this alternative, site soils containing chemicals in excess of cleanup standards would be excavated. Following excavation, soils would be transported off-site to a TSCA-permitted treatment, storage, and disposal facility.

Ground water use would be restricted through deed restrictions on the site. A compliance monitoring network would be installed, and long term monitoring of site ground water would be implemented. The objectives of long term monitoring would be to monitor to demonstrate no further migration of chemical-bearing ground water, and evaluate the performance of remedial actions for soil.

Combined Alternative 3 -

Dechlorination and In-Situ Stabilization of Soil, Extraction of Ground Water and Discharge to a POTW without Pretreatment

Under this alternative, site soils containing chemicals in excess of cleanup levels would be excavated and treated by dechlorination to permanently destroy PCBs. Soils below the effective depth of excavation would be stabilized in-situ by grouting.

The dechlorination process involves heating PCB-bearing soils with a reagent. The reagent is composed of an alkali metal hydroxide (i.e. caustic soda) and a polyglycol (e.g. polyethylene glycol). The chlorine in PCB is chemically removed by the reagent, producing a water soluble organic chemical and an alkali metal hydroxide. Two such methods exist, differing by the addition of solvent to facilitate the reaction. Solvent based methods require further treatment of soil to ensure solvent removal, while solvent free methods generally require higher temperatures to promote reaction.

Studies of the dechlorination process have shown that the products of the reaction are non-toxic, non-mutagenic, and non-bioaccumalative. Field scale tests at the Wide Beach NPL site, New York, and in Guam have shown that removal efficiencies considered equivalent to incineration can be achieved.

Deep soils not dechlorinated would be stabilized by grouting. This process involves the direct injection of stabilization agents, e.g. cement, into the soil. Stabilization would serve to minimize the potential for migration of chemicals from the soil, minimize the permeability at, near, or above the water table, and introduce further reactive chemical species in to the soils. All these factors would serve to inhibit transport of known site chemicals to ground water.

This alternative includes extraction of site ground water to eliminate the migration of chemical-bearing waters. One large extraction well would be installed in the upper 50 feet of the aquifer. A continuous pumping rate of 500 gallons per minute would be required to ensure capture of all potentially contaminated ground water. This alternative calls for discharge of this ground water directly to the City of Spokane Wastewater Treatment Plant, with no pretreatment. A permit would be required.

Combined Alternative 4 -

Vitrification of Soil and Institutional Controls on Ground Water

In this alternative, chemicals in soil will be destroyed by vitrification. Vitrification is a thermal treatment process, whereby an electric potential is applied to an area of soil.

Dissipation of the electric energy heats the soil to a temperature high enough to cause it to melt and fuse into glass. At the same time, the heat mobilizes the contained organic chemicals through pyrolization.Upon contact with air, they burn and are destroyed. Metals are encapsulated in the glass, and immobilized.

PCB Destruction and removal efficiencies equivalent to incineration can be achieved by vitrification.

Shallow soils would be excavated and stockpiled on site to provide access to deeper material. The deep soils will be vitrified in-situ, using a technology scheduled to be demonstrated in the ISV Demonstration Cell. Stockpiled soil would be backfilled into the area, and vitrified over the lower melt. The result would be a mass of chemically inert glassy material left in place. Combustion gases of this process are drawn into a hood and conducted to an off-gas treatment system. Any air discharges will require permit.

Ground water use would be limited through deed restrictions on the site. A compliance monitoring network would be installed, and long term monitoring of site ground water would be implemented. The objective of the long term monitoring would be to determine the performance of vitrification in removing and destroying chemicals of concern, and ensure no further migration of contaminated ground water.

Combined Alternative 5 -

On-site Incineration of Soil, Extraction and Pretreatment of Ground Water by Filtration and Carbon Treatment, and Discharge to a POTW

Under this alternative, PCBs in soil would be destroyed by incineration. Soils would be excavated from the West Dry Well area, classified according to size, and fine PCB bearing material would be stockpiled. Soils containing metals above incinerator operator specifications would be transported off-site for disposal.

Incineration must, by federal rule (40 CFR Part 761.70) achieve "six 9's" (99.9999%) destruction removal efficiency of PCBs.

A mobile incinerator would be transported on-site, and used to thermally treat the soil, destroying the PCBs. The treated soil would be backfilled in to the excavation. Deep soil would be treated first, and then shallow soils would be removed around the site and treated. The mobile incinerator would employ best available control technologies (BACT) on any discharge.

Ground water would be extracted, containing the area of known PCB bearing waters. The extracted water would be filtered to remove particulate matter, and then water would proceed to canisters of activated carbon. Particulate material would probably contain 90% of the PCBs. This material would be filtered out of the water, and characterized prior to disposal. Dissolved PCBs would be removed by the carbon adsorption stage. Liquid discharge from this treatment system would be discharged under permit to the sanitary sewer system for final treatment and disposal at the Spokane Wastewater Treatment Facility.

CLEANUP ACTION CRITERIA

The Model Toxics Control Act Cleanup Regulation describes the requirements for selecting cleanup actions (WAC 173-340-360). Included in these requirements are criteria for approving cleanup actions, policies regarding permanent solutions, and the order of preference for cleanup technologies. All cleanup actions must meet the following four threshold requirements.

- Protect Human Health and the Environment
- Comply with Cleanup Standards
- Comply with Applicable State and Federal Laws
- Provide for Compliance Monitoring

The selected cleanup action must also:

- Use permanent solutions to the maximum extent practicable
- Provide for a reasonable restoration time frame
- Consider public concerns raised during public comment on the draft cleanup action plan.

Cleanup technologies are prioritized to minimize the amount of untreated hazardous substances remaining at a site. MTCA cleanup priorities, listed in order of descending preference, are:

(1) Reuse or recycling;

(2) Destruction or Detoxification;

(3) Separation or volume reduction followed by reuse, recycling, destruction or detoxification of the residual hazardous substance;

(4) Immobilization of hazardous substances;

(5) On-site or off-site disposal at an engineered facility designed to minimize the future release of hazardous substances and in accordance with applicable state and federal laws;

(6) Isolation or containment with attendant engineering controls, and;

(7) Institutional controls and monitoring.

Preference is given to treatments which generate permanent solutions to the maximum extent practicable. Criteria for deciding what is a permanent solution include:

- Overall protection of human health and the environment
- Long term effectiveness, including a degree of certainty the alternative will be successful
- Short-term effectiveness, including protection of human health and the environment during implementation
- Permanent reduction in toxicity, mobility and volume of hazardous substances
- Implementability
- Cleanup costs, when selecting between two alternatives having an equivalent level of preference.

EVALUATION OF PROPOSED REMEDIAL ACTION ALTERNATIVES

Threshold Criteria

In comparing the combined remedial action alternatives presented in the FS with the threshold criteria [WAC 173-340-360(2)] (Table 6), all alternatives except the no action alternative are acceptable. All proposed actions will comply with cleanup standards. All provide for monitoring to demonstrate compliance is achieved. All actions will comply with applicable state and federal laws, and all will be protective of human health and the environment. (Table 6)

Other Requirements

Use of Permanent Solutions

When selecting a cleanup action, preference shall be given to permanent solutions to the maximum extent practicable. A permanent solution is one in which cleanup standards can be met without further action being required at the site, other than the appropriate and approved disposal of residue from application of the treatment technology.

The criteria for determining whether a cleanup action is permanent to the maximum extent practicable are outlined in WAC 173-340-360(5)(d). Combined alternative 1, the No Action alternative, is not evaluated. Table 8 illustrates a subjective evaluation of criteria for each combined alternative 2 through 5 in each environmental medium.

Overall Protectiveness

Overall protectiveness of human health and the environment means the degree to which existing risks will be reduced. It includes consideration of the time necessary to reduce risk and reach cleanup standards, on-site and off-site risks related to the action, and the chances that the cleanup may perform to higher standards than specific cleanup standards.

All soil treatments rank high for overall protectiveness, though the off-site disposal option is somewhat lower than on-site treatment because it does not actually destroy the chemicals. Ground water alternatives involving extraction rank somewhat higher than those involving institutional controls, because some mass of chemical will be physically removed from ground water.

Long Term Effectiveness

This term is a measure of the degree of certainty that the action will be successful, and the magnitude of residual risk.

For soils, all treatment options rank higher than the off-site disposal option because chemicals will be destroyed by treatment. Dechlorination and vitrification are both innovative technologies, but have been shown to have the capability for permanent and irreversible treatment of the chemicals. Incineration is the main technology for achieving this goal. Such treatment renders the residual risk well below levels of concern.

In ground water, extraction options rank higher than institutional controls. Extraction and treatment, either through pre-treatment or at the POTW, should provide permanent removal of PCBs from the environment. Given the low level concentrations of PCBs coupled with uncertainties regarding extraction methodology, the method may not work. Institutional controls will retain some residual risk.

Short Term Effectiveness

This is a measure of the protection of human health and the environment during implementation of the alternative.

Off site disposal, incineration, and vitrification all have a measure of short term risk of exposure. Remedial workers risk exposure to dust or gases. Off site disposal risks exposure through fugitive dust emissions or spills in transit; vitrification and incineration both generate off gases which must be managed. These risks are managed through proper handling and treatment methods during operations. Dechlorination ranks somewhat higher than other alternatives in this case, as few gases or products are generated.

All ground water alternatives rank equally over the short term, as neither extraction methods or institutional controls on usage are expected to perform in the short term.

Reduction in Toxicity, Mobility, and Volume of Contaminants

This includes analysis of the ability of the alternative to destroy the hazardous substance, abate the continued release of hazardous substance, reduce the exposure likelihood to residual products, and the characteristics and quantity of treatment residuals.

Of the soil treatment methods, incineration and vitrification rank high by virtue of their ability to irreversibly destroy entrained organic chemicals. Vitrification will immobilize metals in an in-place molten mass. Incineration may require some management of metal-bearing residual material. Both methods will abate future releases, though vitrification ranks somewhat higher again due to the low permeability of the residual, relative to the ash left from incineration. Dechlorination will reduce the total volume of chemical by treatment. The toxicity and mobility of materials below cleanp levels will not be reduced. Dechlorination also generates some residual products which will require management. Off site disposal does not reduce the toxicity, mobility, or volume of chemical, but does remove contaminated material to a secure landfill.

Ground water methods are dependent upon the soil source control methods for reduction in volume. PCBs are of low solubility, so mobility in ground water is low. Extraction will further reduce the mobility of contaminants, but the toxicity will remain unchanged until treatment methods and efficiencies are determined. Volume of contaminant may be reduced. Institutional controls will not change toxicity, mobility, or volume of site ground water.

Implementability

This category is a measure of availability of technologies, as well as the availability and complexity of the construction effort.

Off site disposal of soil is straightforward technology, using conventional construction methods and equipment. Dechlorination and vitrification technologies are considered innovative. Dechlorination has been demonstrated commercially, but equipment availability is uncertain. Vitrification has not been commercially demonstrated, but a full scale demonstration project is planned on-site. Incineration technology is proven, and provided by many vendors, but local community acceptance is problematic.

Both extraction and institutional control methods for ground water are proven and implementable. Construction of the extraction and treatment systems would need to wait until soil treatment alternatives are implemented.

Cost

A cleanup action shall not be considered practicable if the incremental cost of the cleanup action is substantial and disproportionate to the incremental degree of protection it would achieve over a lower preference alternative. This means that when two or more alternatives provide the same protection of human health and the environment, and the hierarchy of technologies is similar, preference may be given to the least cost alternative. Table 4-6 of the FS outlines cost estimates for the various alternatives.

Off site disposal of soil is the least costly alternative. Dechlorination of soil is the next costly, and vitrification is slightly more expensive. Incineration is the most expensive soil treatment.

Ground water alternatives involving extraction are significantly more expensive than institutional controls. Institutional control alternatives involve some cost in establishing monitoring points and sampling. These costs are necessary in the extraction options, too. Extraction options also require capitalization of pumps, wells, and treatment systems, and operation and maintenance costs of those pumps, together with permit fees and per-gallon discharge fees.

Taken together, off-site disposal and institutional controls are the most economical. Vitrification/institutional controls and dechlorination/extraction and discharge are comparable in cost, and incineration/extraction and discharge is the most expensive.

Reasonable Restoration Time Frame

A reasonable restoration time frame for remedial action is mandated by the Model Toxics Control Act. Criteria for evaluating restoration times are outlined in the MTCA regulations, Ch. 173-340-360(6).

The FS discusses construction and implementation times for the various combined alternatives under the individual discussions, Chapter 4. In general, soil alternatives can be implemented in less than 24 months. Time to implement varies with the method. Excavation and off-site disposal, for example, could be implemented nearly as soon as weather permits construction. As soon as chosen soil alternative is performed, cleanup standards for soils will have been met.

Ground water methods may require some additional time. Institutional controls and monitoring can be in place nearly as soon as well construction is completed, prior to implementation of a soil alternative. Alternatively, active extraction and treatment alternatives may take 12 months or more following implementation of soil remediation. This time allows for construction of infrastructure (e.g. treatment systems, buildings, wells, etc.) and for application and receipt of a discharge permit.

The time to reach cleanup standards in ground water is highly uncertain. Performance data available nationwide seriously questions the ability of "pump-and-treat" methods to restore ground water. Given the hydrogeologic conditions at this site, extraction methods must be considered to represent only containment. Institutional controls will perform the same function, that of isolating the chemical substance from potential receptors. Institutional controls and extraction methods are thus considered as equivalent for this site in terms of restoration time.

Consideration of Public Concerns

Ecology received no public comment following review of the RI/FS reports in August, 1992. Public input was considered in the development of this final cleanup action plan. Agency responses are in Appendix C.

Cleanup Technology Preference

The MTCA regulation, WAC 173-340-360(4), requires cleanups to use technologies which minimize the amount of untreated hazardous substances remaining at a site. The regulation establishes ranked preference criteria for technology types.

Table 8 compares the proposed combined alternatives with the priority list. No alternative proposes recycling or reuse of hazardous substances on site. The soil treatment alternatives, incineration, vitrification, and dechlorination all destroy or detoxify the chemical residues above levels of concern. All involve separation and volume reduction, by prior screening of soil. These soil alternatives are equivalent in preference.

Ground Water alternatives meet somewhat lower priority technologies. This is usual for ground water contaminated at low levels. Extraction and treatment alternatives are somewhat higher priority technologies, simply because they remove some mass of material and remove hazardous substances. These substances are then transferred to another medium, i.e. activated carbon, and disposed off site. The actual extraction process will not restore the aquifer at this point, so it is considered equivalent to containment.

Institutional controls are low priority technologies, but, given the chemical properties of PCBs, they represent isolation of hazardous substances from the human contact. Thus, extraction and institutional controls are considered equivalent priority technologies at this site.

PROPOSED CLEANUP ACTION

The primary selected cleanup action for the GE/Spokane Site is vitrification of soil and institutional controls for ground water. When coupled with other institutional controls necessary for cleanup levels developed under WAC 173-340-745, it will provide for long term protection of human health and the environment, and ensure that all ARAR's are met. It is also consistent with Ecology's recognition [WAC 173-340-360(9)(c)] that treatment of large volumes of relatively low level materials is often impracticable, and that protection of human health and the environment is assured by implementing a long term monitoring program and institutional controls "...until residual hazardous substance concentrations no longer exceed site cleanup levels..."[WAC 173-340-360(8)(b)].

Due to the unproven nature of vitrification technology, it is prudent to present a contingent remedy to assure that ultimate remedial action objectives are met. The contingent remedy, dechlorination of shallow soil and immobilization of deep soil, will be implemented should ISV be unavailable or otherwise not feasible.

PRIMARY CLEANUP ACTION

The selected Cleanup Action will proceed following agreement on terms and conditions of a MTCA Consent Decree between the State of Washington and General Electric Company. The agreement will provide for the following actions.

- Institutional Controls and Monitoring of Ground Water and Soil

  Institutional controls are a vital element of the cleanup action plan to ensure protection of human health. WAC 173-340-440 requires institutional controls when the cleanup action results in residual concentrations of hazardous substances that exceed cleanup levels. WAC 173-340-745 requires institutional controls on sites where cleanup levels have been set using industrial soil assumptions. At this site, institutional controls include restrictive covenants on extraction and use of ground water. These covenants shall be placed on the deeds of properties where ground water is impacted. In addition, restrictions and notices governing handling and disposal of site soils shall be placed on the deeds of affected properties.

  Draft covenants will be approved by the Department prior to their adoption.

  The current well network is inadequate to monitor performance of soil treatment efforts and rate and extent of contaminated ground water. The cleanup action will include abandonment of all wells which are not useful for these objectives, and installation and sampling of wells which can accomplish the objectives. Sampling will commence as soon as practicable, and continue through the soil cleanup effort and until such time as compliance with ground water cleanup levels are reached.

  Sampling of these wells will be performed for PCBs. Laboratory analysis should achieve detection limits which meet or exceed the cleanup level set for the site.

A sampling and analysis plan meeting the requirements of WAC 173-340-820 will be written by GE and approved by Ecology. This plan will identify data analysis and evaluation procedures that will be used to demonstrate and confirm compliance with cleanup standards. This will include well locations and sampling devices, a description of all proposed statistical methods for data analysis, and laboratory quality assurance methodology.

- Vitrification of Soils

  Upon successful completion of the ISV demonstration test, vitrification will be employed to treat on site soils. Shallow soils will be excavated, treated by screening to segregate large cobbles, and stockpiled within the area of contamination. Deep soils containing chemicals above cleanup levels will be treated with in-situ vitrification techniques. Stockpiled soil for treatment will be backfilled on top of the lower melt and vitrified.

- Compliance Monitoring

  Ground water monitoring will proceed as outlined above. Soil sampling will be conducted to document vitrification addressed soils above cleanup levels. Samples of treatable soils will be compared to samples of vitrified material to demonstrate destruction efficiency. The details of this sampling efforts will be outlined in a sampling and analysis plan, and approved by Ecology.

Discussion

Selection of a remedial action at this site requires a consideration of whether ground water extraction and treatment is appropriate. The objectives of ground water extraction methods include the control of a contaminant plume to prevent further migration of contamination, and to lower the concentration of contaminants. The effectiveness of extraction systems in achieving ground water cleanup level goals through contaminant removal has recently been a subject of discussion in the scientific community. (See, for example, Haley and others, 1991; Doty and Travis, 1991)

Ground water extraction technologies have been shown to be relatively successful at reducing contaminant mobility through containment. Restoration of water quality to health based standards through this method, though, may require time frames of 100 to 1000 years.

Ground water extraction, to be effective, depends upon the mobility of the contaminant, and the physical properties of the aquifer. PCBs have a very low solubility, and a very high sorption coefficient, as previously discussed (Appendix A). Large volumes of water must be "flushed" through the aquifer to release minimal volumes of contaminant. In the Spokane Aquifer, extraction of these large volumes of water will involve substantial pumping and treatment capacity. Little mass of contaminant would be extracted with the water.

The ultimate objective of this extraction would be to limit exposure of PCBs to individuals. Institutional controls will serve the same end, at a much lesser cost. The department has determined that the incremental cost of ground water extraction is substantial and disproportionate to the incremental degree of protection and degree of environmental restoration it would achieve over implementation of institutional controls.

Soil vitrification rates very high in terms of overall protection of human health and the environment, compliance with ARARs, long and short term effectiveness, and permanence. Implementability has not been determined, but is scheduled to be demonstrated on site. The advantages of this technology through destruction of chemicals far outweigh the uncertainties of implementability.

CONTINGENT REMEDY

The implementibilty issue regarding vitrification is significant. To avoid costly delay in revising the FCAP, and renegotiation of Consent Decrees or other legal instruments, the Department of Ecology proposes to implement a contingent remedy should vitrification prove unavailable or should it not perform to standards dictated by ARARs.

Should vitrification be unavailable, General Electric will perform stabilization of deep soil through grouting, and excavation and dechlorination of shallow soils. This alternative ranks nearly as high as vitrification in terms of protection of human health and the environment, long and short term effectiveness, and permanence. Deep soil stabilization ranks lower than destruction of PCBs via vitrification, as toxicity and volume of deep soils will not be reduced.

Performance Criteria

The contingent remedy shall be implemented upon notification that ISV technology is unavailable because of 1 or more of the following reasons:

1. The ISV demonstration test is unsuccessful in destroying PCBs to levels acceptable under TSCA.

2. The ISV demonstration test is unavailable to be performed in a reasonable time, taken in this context to mean that mobilization will not be complete prior to January 1, 1995.

3. The ISV demonstration test is unavailable to be performed because a permit to demonstrate the technology at the GE/Spokane Site, required by EPA, is not issued.

EVALUATION OF CLEANUP ACTION WITH RESPECT TO MTCA CRITERIA

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The major exposure routes from the site are from ingestion of or contact with PCB contaminated ground water and soil. Institutional controls restricting use of contaminated ground water will provide short term protection of human health. Destruction of PCBs in soil through vitrification will remove the continuing source of contaminants and also provide a low-permeability mass limiting infiltration and transport of material below cleanup standards. This level of destruction and source control will provide long-term protection of human health and the environment. Incidental direct contact with soil will be minimized through institutional controls on the site, alerting potential site operations to the remaining chemical hazards.

The contingent soil remedy will destroy PCBs in shallow soil, and immobilize those in proximity to ground water.

COMPLIANCE WITH CLEANUP STANDARDS

All soils containing PCBs above standards protective of ground water will be vitrified, and entrained PCBs will be destroyed. All remaining soil on site will be bound by institutional controls on their handling and disposal.

The contingent remedy will destroy all PCBs in shallow soils above cleanup standards and immobilize those above cleanup criteria in proximity to ground water.

COMPLIANCE WITH APPLICABLE STATE AND FEDERAL LAWS

The cleanup action at the GE/Spokane site complies with applicable federal and state laws. Federal and State laws applicable to the proposed cleanup actions are identified in Table 9. Local laws which are more stringent than the specified federal and state laws will govern when applicable.

COMPLIANCE MONITORING

Compliance monitoring consists of three categories: protection, performance, and confirmational monitoring (WAC 173-340-410). Protection monitoring confirms that human health and the environment are protected during construction and operation and maintenance of the cleanup action. Performance monitoring confirms the cleanup action has attained cleanup standards and other performance based criteria. Confirmational monitoring confirms the long term effectiveness of the cleanup action once cleanup standards are attained.

General Electric will prepare and submit compliance monitoring plans for Ecology review and approval. The plans will describe how data is to be obtained, assured, and interpreted, and the conditions upon which additional remedial actions will be required. Methods for data confirmation and reporting will be included. A site safety and health plan (WAC 173-340-810) and a sampling and analysis plan (WAC 173-340-820) will also be included as part of the compliance monitoring plan. All cleanup actions and long-term monitoring will be conducted in accordance with these plans.

USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

Destruction of PCBs in-situ is considered a permanent solution under MTCA. Dechlorination of shallow PCBs is also destruction. Deep soil stabilization is considered containment. Monitoring and institutional controls on ground water and soil, by themselves, are not permanent solutions. MTCA recognizes that permanent solutions may not be practicable for all sites. The cleanup action must satisfy the criteria outlined in WAC 173-340-360(5)(d) used to determine whether the cleanup is permanent to the maximum extent practicable.

Protection of Human Health and the Environment

Vitrification of PCBs will provide overall protection of human health as previously discussed. Attainment of ground water cleanup standards resulting from the cleanup action will be assessed as part of the 5 year review required under WAC 173-340-420. If ground water standards have been attained at that time, no additional cleanup action will be required by Ecology. If, in Ecology's opinion, ground water concentrations are approaching cleanup levels, additional monitoring will be required. If there is no trend indicating a reduction of concentrations of hazardous substances, Ecology may require additional remedial action.

Long Term Effectiveness

Long-term effectiveness will be achieved by destruction of PCBs in soil. If, however, no decrease in contaminant levels is noted in ground water over time, ground water extraction and treatment may be necessary.

Short Term Effectiveness

Risks associated with the cleanup action include potential exposure of workers to dust and soil during construction activities, and exposure to gases during operation of the ISV unit. Similar risks will accompany dechlorination processing. Mitigation measures will be part of the remedial design, and on-site monitoring will be conducted.

Transport, storage, and disposal of reagents and residual products may be regulated by applicable regulations.

Permanent Reduction of Toxicity, Mobility, and Volume

Vitrification will reduce the toxicity and volume of PCBs by destruction. Dechlorination will also reduce the toxicity and volume by destruction. Deep soil grouting will immobilize contained contaminants.

Implementability

As previously discussed, a contingent remedy is presented given the uncertainties in implementability of vitrification technology.

Cost

The 1992 cost estimates for the various cleanup technologies are included in figure 8 (Bechtel, 1992).

PROVIDE REASONABLE RESTORATION TIME FRAME

The proposed cleanup actions will limit continued discharge of PCBs to ground water from soil, and limit exposure to PCBs at the surface. Additionally, ground water exposures will be limited by institutional controls. The time frame necessary for these actions is difficult to determine. Given the contingent remedies for soil, and the indefinite time required for ground water to reach cleanup levels, the approach including periodic review is the best to meet the overall goals of the MTCA.

PUBLIC PARTICIPATION AND COMMUNITY ACCEPTANCE

MTCA regulations require public concerns regarding the proposed cleanup alternatives be addressed. A public comment period for this document has allowed the public and affected parties a chance to comment on the proposed action. Public comments and concerns were be evaluated in developing this final cleanup action plan. A responsiveness summary, submitted as part of the final cleanup action plan, is in appendix C.

IMPLEMENTATION SCHEDULE

General Electric Company is to submit the following documents to Ecology within ninety days of the date of signing the Consent Decree implementing this Cleanup Action Plan:

- Institutional Control Plan
- Sampling and Analysis Plan
- Ground Water Monitoring Plan
- Soil Treatment Plan and Schedule

The Soil Treatment Plan will indicate mobilization of ISV equipment prior to January 1, 1995.

Ground water monitoring devices and institutional controls will be in place 180 days following signing the Consent Decree. Ground water monitoring will begin as soon as possible, but in no case later than January 1, 1994.

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U.S. EPA, 1990: Guidance on Remedial Actions for Superfund Sites with PCB Contamination; OSWER Directive 9355.4-01

U.S. EPA, 1990b: Health Affects Summary Tables, First/Second Quarters FY-1990; OERR 9200.6-303(90-1/2)

U.S. EPA, 1991, Integrated Risk Information System

Figure 1. Location of the GE/Spokane Site

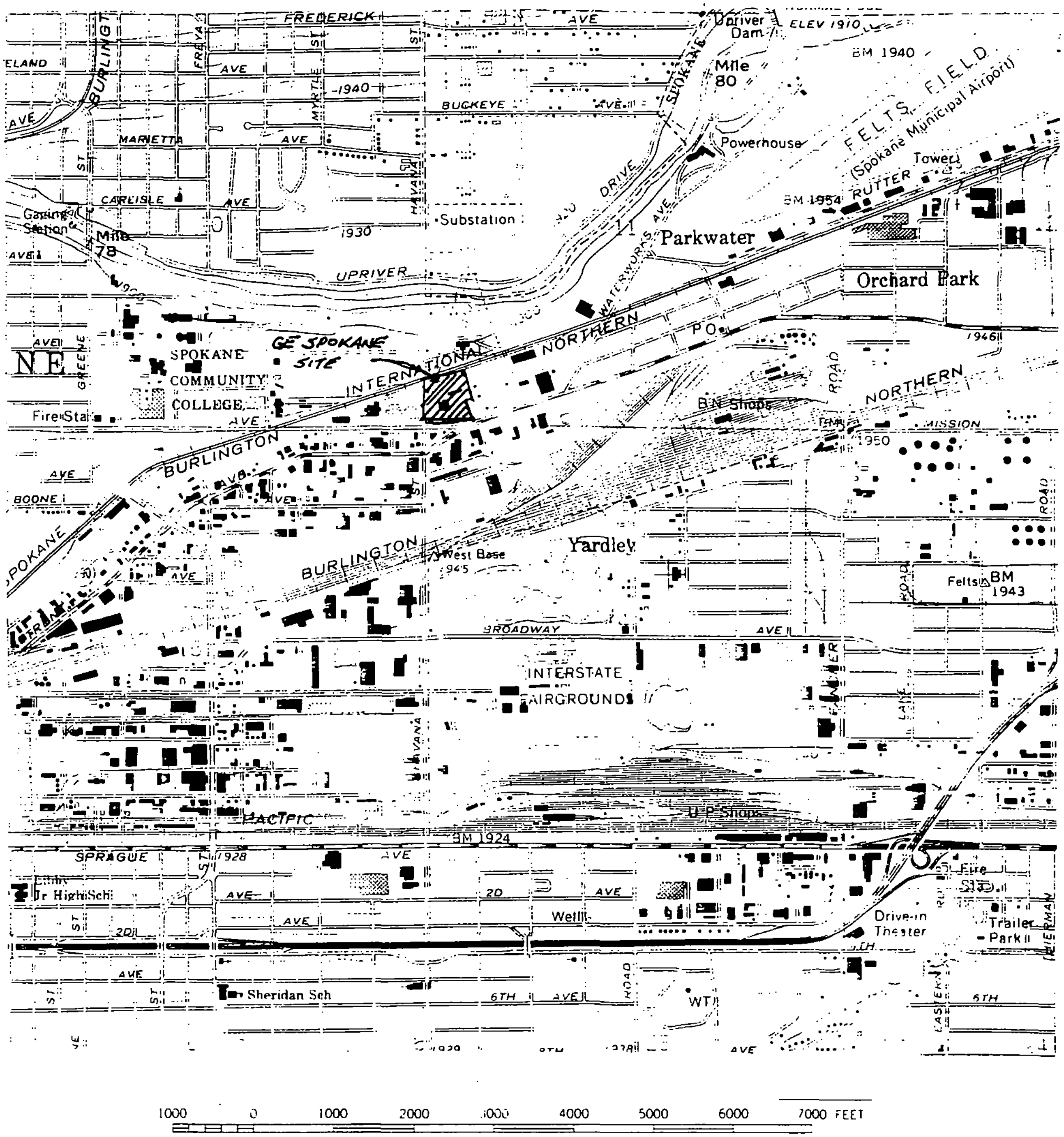

Figure 2. Documents Required Under the Model Toxics Control Act Cleanup Regulation (Ch. 173-340 WAC)

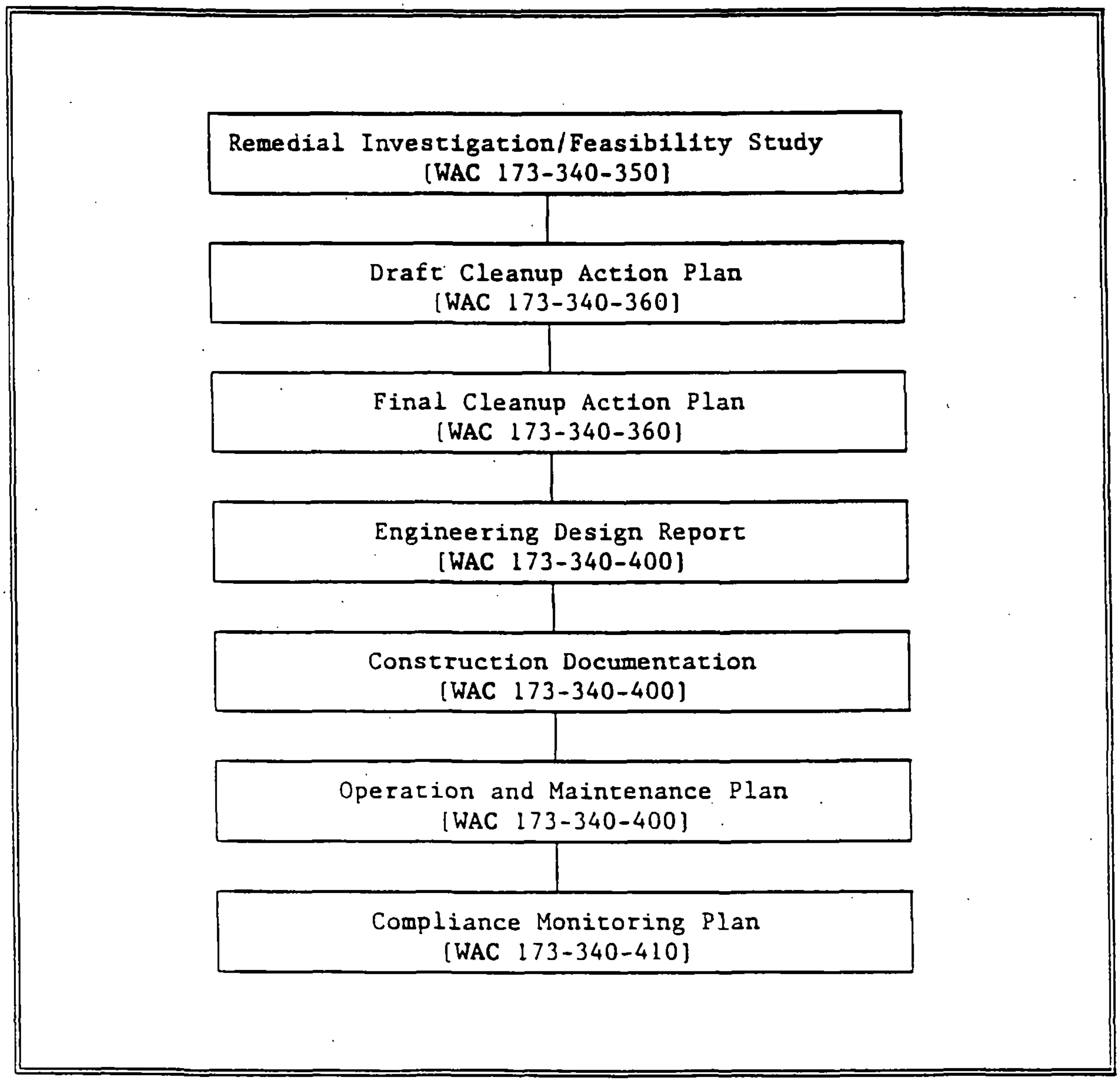

Figure 3. Site Ownership and Former Facilities (Bechtel, 1992)

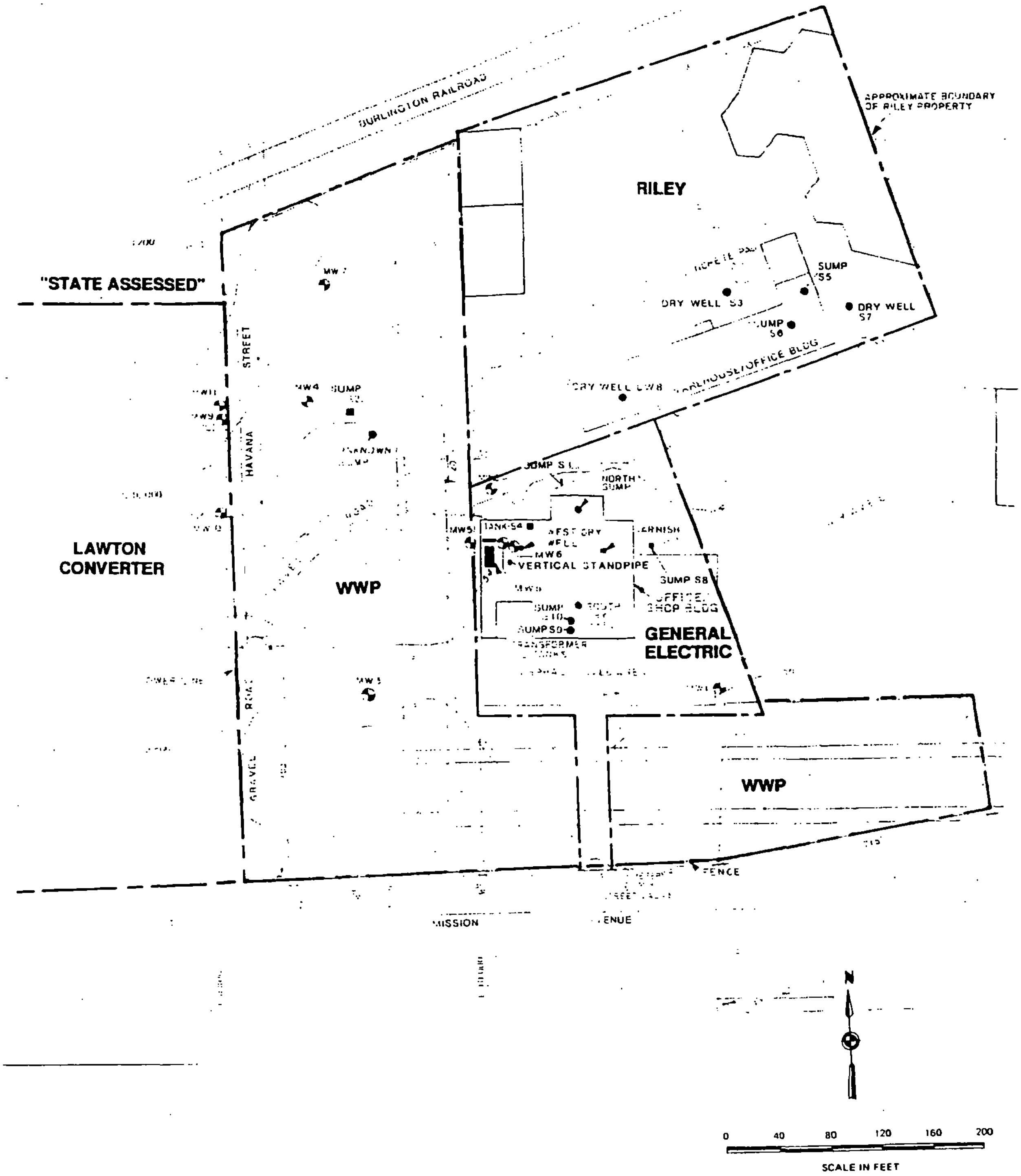

Figure 4. PCBs in Shallow Soils (Bechtel, 1992)

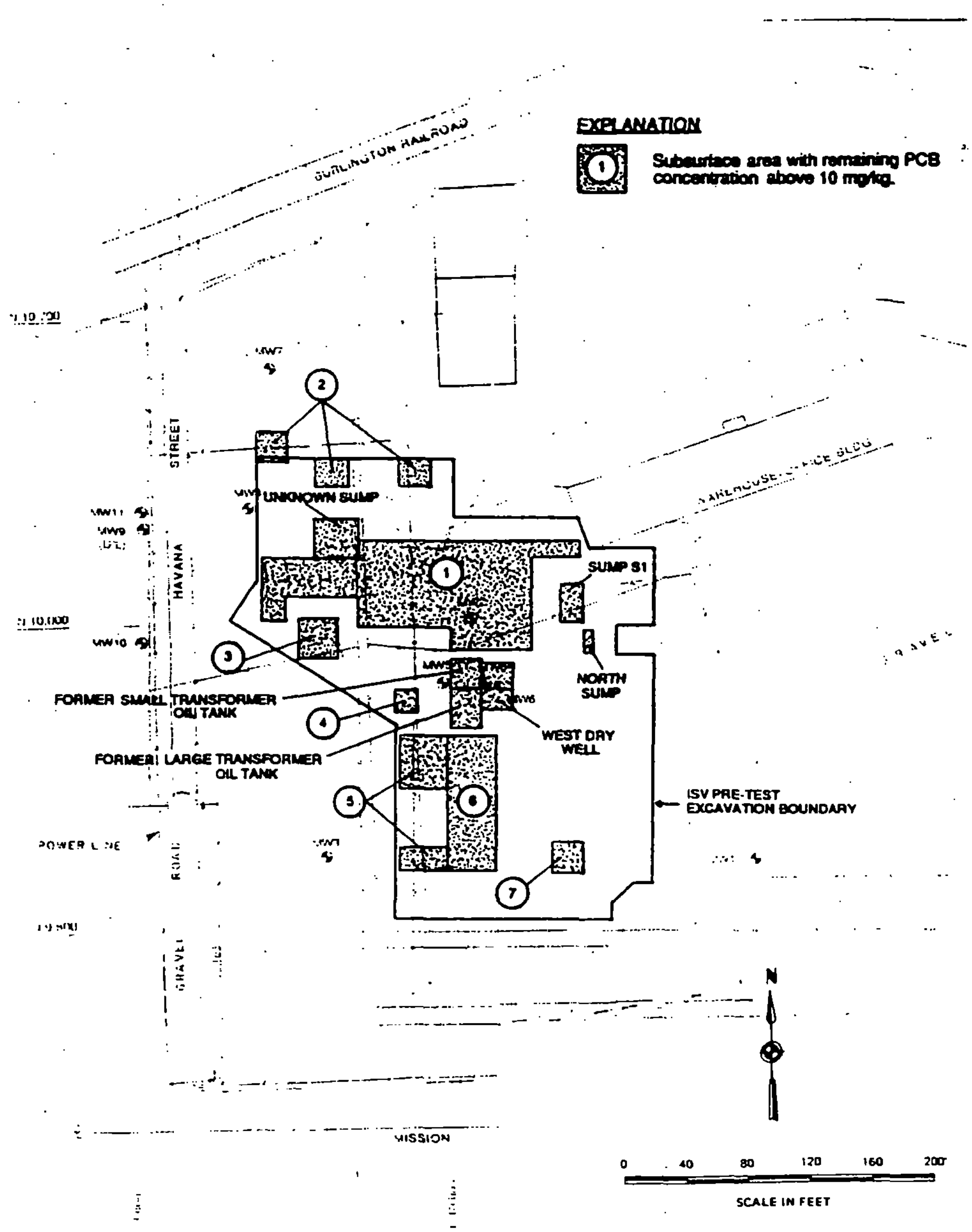

Figure 5. PCBs in the West Dry Well Soils (Bechtel, 1992)

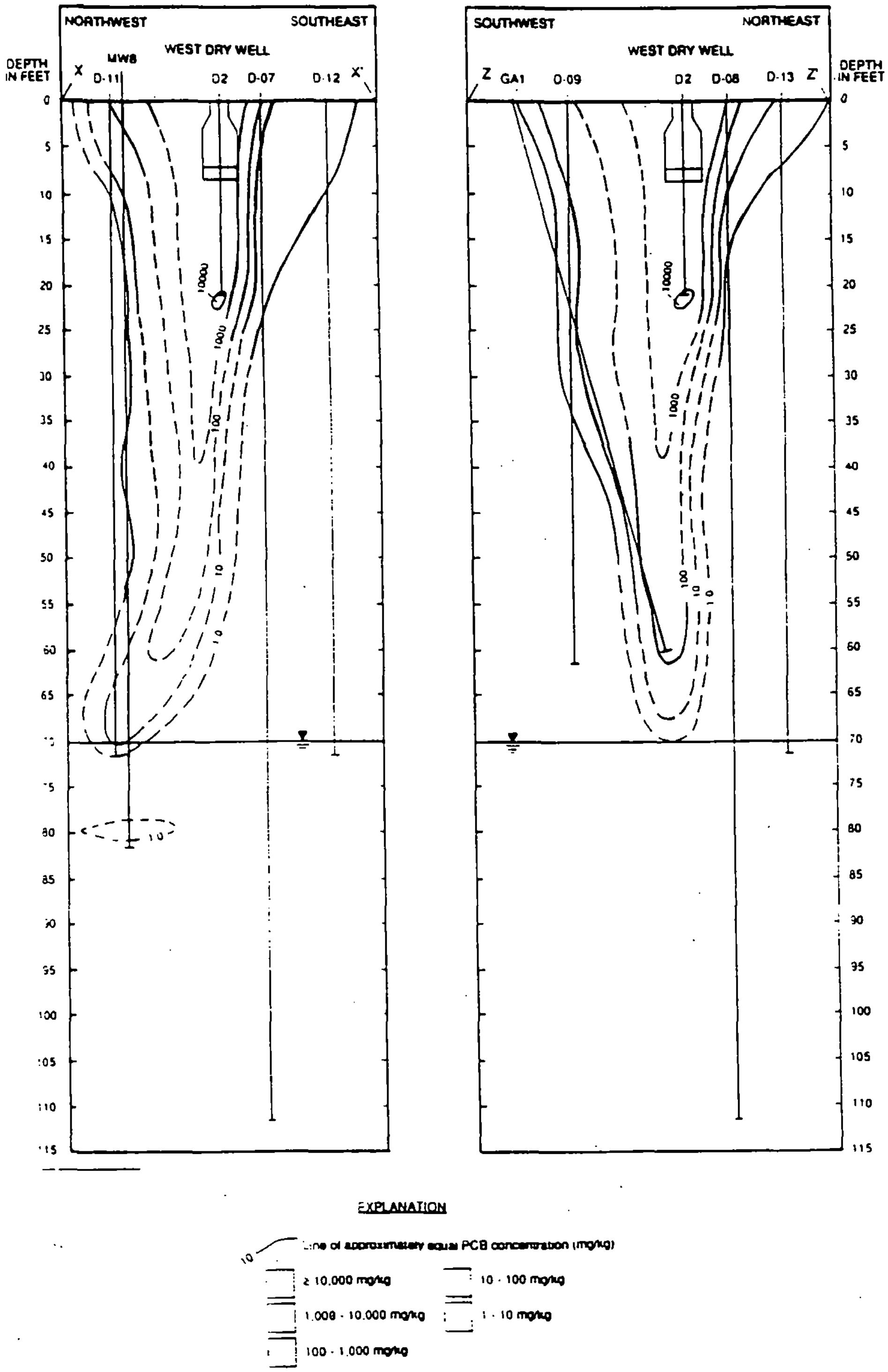

Figure 6. Maximum Concentrations of PCBs in Ground Water (Bechtel, 1992)

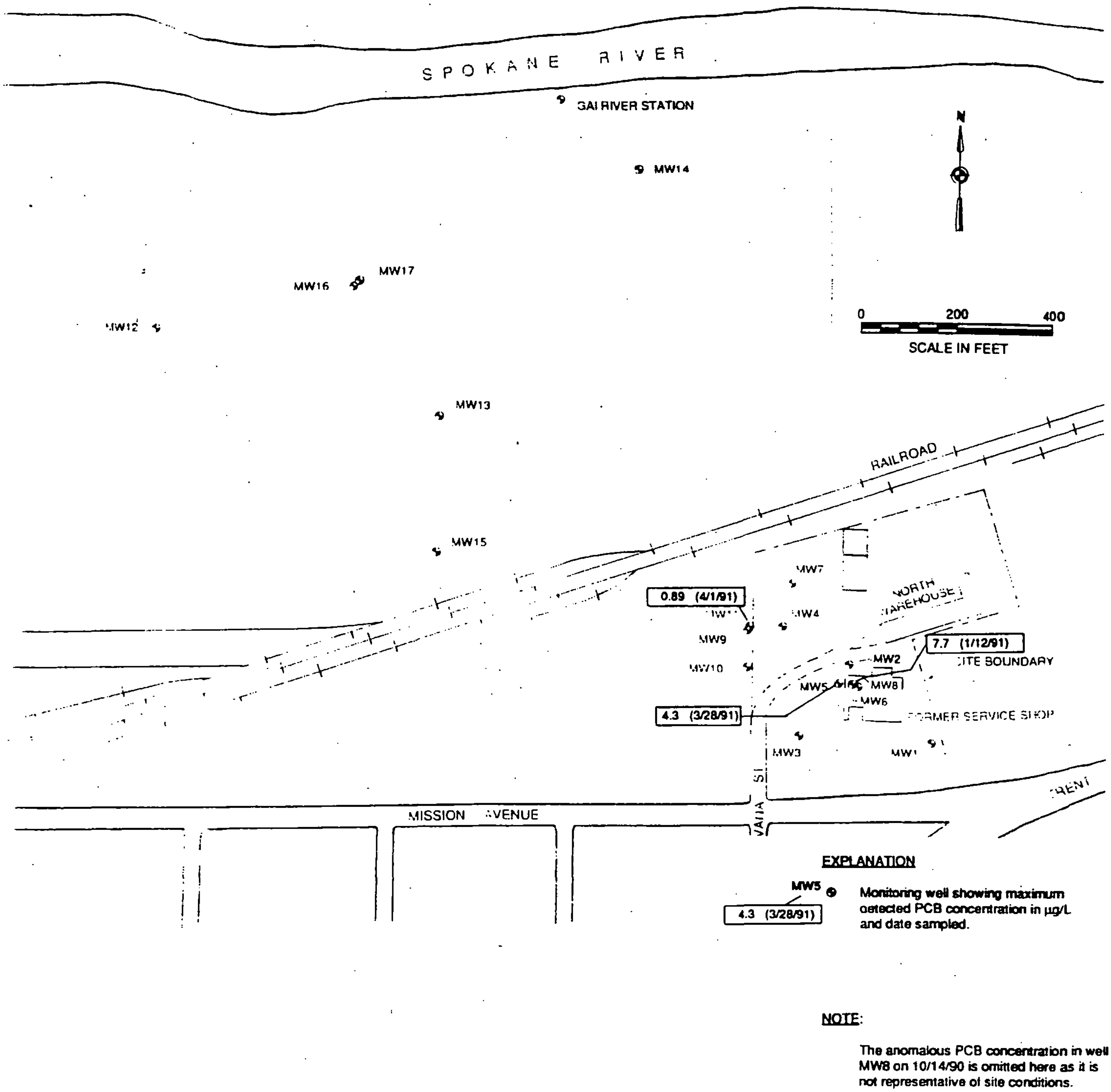

Figure 7. Location of Surface Backfill following Interim Action (Bechtel, 1992)

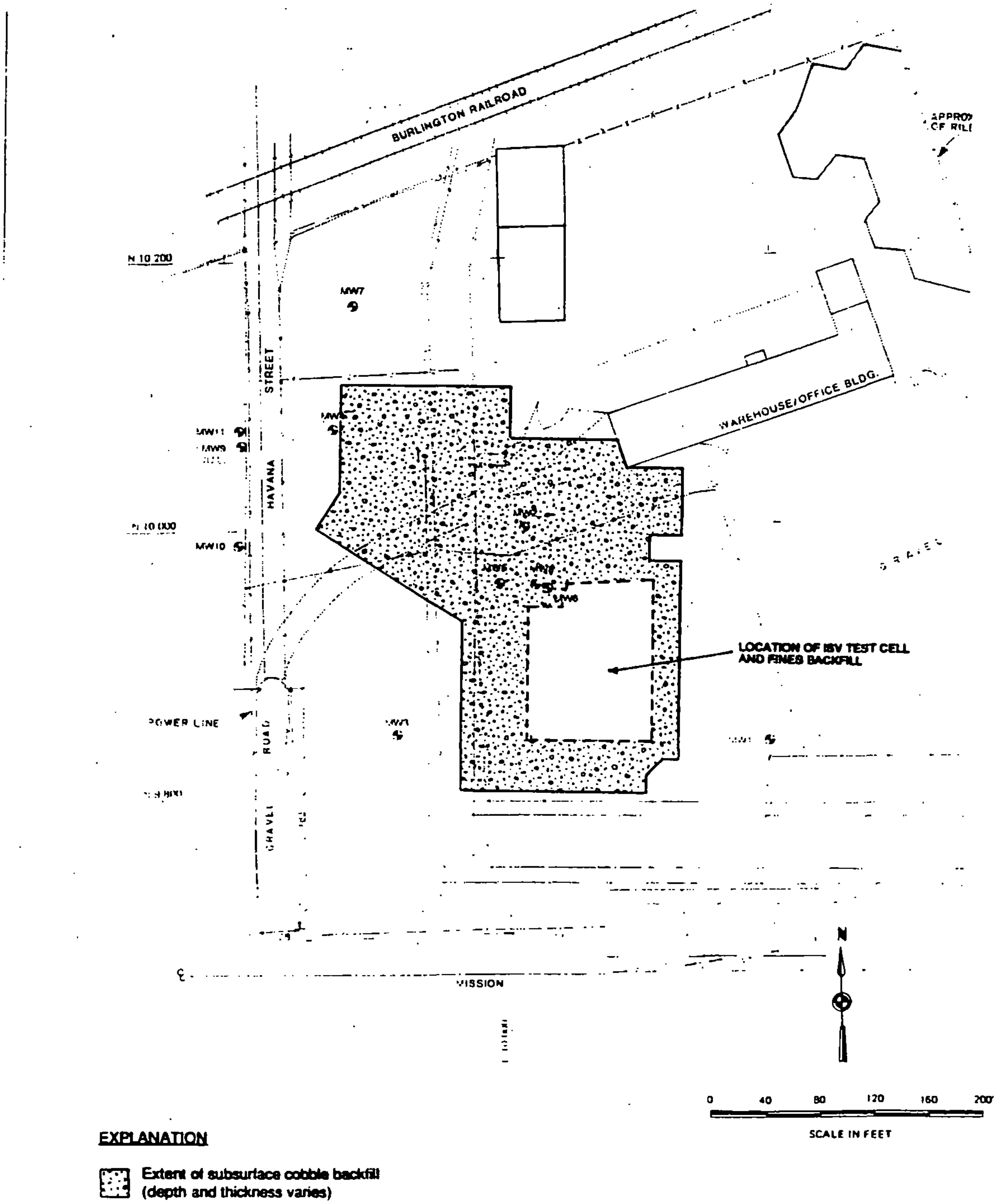

Figure 8. Cost Estimates for Cleanup Alternatives (Bechtel, 1992)

SELECTED COMBINED REMEDIAL ALTERNATIVES FOR SOIL AND GROUND WATER

COMBINED ALTERNATIVE	SOILS REMEDIAL ALTERNATIVE	SOIL PV COST $1000	GROUND WATER REMEDIAL ALTERNATIVE	GW PV COST $1000	TOTAL PV COST $1000
S1/GW1	S1 - No action	100	GW1 - No action	0	100
S3/GW2	S3 - Excavation, screening, and offsite disposal of shallow and deep soils	3,300	GW2 - Institutional controls with ground-water monitoring	900	4,200
S6/GW5	S6 - Excavation, screening, and dechlorination of shallow soils; in-situ stabilization of deep soils	4,600	GW5 - Extraction with discharge to publicly owned treatment works (no pretreatment)	2,300	6,900
S8/GW2	S8 - Excavation, screening, and vitrification of shallow soils; in-situ vitrification of deep soils	6,700	GW2 - Institutional controls with ground-water monitoring	900	7,600
S7/GW3	S7 - Excavation, screening, and onsite incineration of shallow and deep soils	10,900	GW3 - Extraction with filtration/carbon treatment and discharge to publicly owned treatment works	4,800	15,700

Table 1
Concentrations of Chemicals in Ground Water

Chemical	Frequency of Detection[a]	Maximum Concentration (ug/l)	ARAR Standard (ug/l)[e]	Basis	Method B Cleanup Level (ug/l)[f]	Basis
Polychlorinated Biphenyls (PCBs, total)[c]	0.35	6.54[b]	0.1	Method B, PQL	0.0114	BCAR
Benzene	0.16	5.6	5.0	MCL	1.5	BCAR
Tetrachloroethene	0.53	0.75	5.0	MCL	0.858	BCAR
Trichloroethane	0.53	0.33	200	MCL	0.720	BNCAR
Trichloroethene	0.20	20	5.0	MCL	3.98	BCAR
Xylenes	0.20	2.4	10000	MCL	16	BNCAR
Tetrachlorobenzene, 1,2,3,5	0.1	2.6(j)			4.8	BNCAR
Total Petroleum Hydrocarbons	1.00	17	10000	aesthe tics		
Diethyl Phthalate	0.08	1(j)			12.8	BNCAR
Lead	0.09	0.007[d]	5	MCL		
Zinc	0.77	0.2	5	MCL	3.2	BNCAR

(a)Frequency of detection calculated on wells MW-1 through MW-11; MW-12 through MW-17 modeling wells excluded.
(b)Result for Aroclor 1260, 10/14/90, not included - Data indicate this value associated with high turbidity resulting from site disturbance
(c)Source: Ecology and Environment, 1992
(d)Background concentration
(e)Value from WAC 173-340-720(2)(a)(i), Table 1
(f)Values: BNCAR calculated according to WAC 173-340-720(3)(a)(ii)(A)
BCAR calculated according to WAC 173-340-720(3)(a)(ii)(B)
(j) Laboratory qualified data

Table 2
Concentrations of Chemicals In Soil

Chemical Name	Industrial Soil Cleanup Level (mg/kg)	Method[a]	Maximum Concentration above 15 feet below ground surface[b]	Maximum Concentration Below 15 feet depth[b]
Arsenic	188	CCAR	34	5.6
Antimony	1400	CNCAR	4.2	ND
Beryllium	30.5	CCAR	45.8	46.4
Cadmium	1750 10	CNCAR AGW	260	ND
Chlorobenzene	7000	CNCAR	ND	1.438
Chromium (VI)[c]	17500 500	CNCAR AGW	470	24.4
Copper	210000	CNCAR	32100	5520
Ethylbenzene	350000 20	CNCAR AGW	0.44	ND
Hexane;n-	210000	CNCAR	0.0028	0.0006
Lead[d]	200	AGW	1110	14.5
Mercury	1050 1	CNCAR AGW	0.8	ND
Methylene Chloride	17500 1	CCAR AGW	0.004	0.7
Nickel; soluble salts[c]	70000	CNCAR	2800	24
Polychlorinated Biphenyls (PCBs)	17 10	CCAR ACAR	9966	21400
Selenium	10500	CNCAR	9	6
Silver	10500	CNCAR	132	ND
Tetrachlorobenzene;1,2,4,5	1050	CNCAR	ND	ND
Tetrachlorobenzene;1,2,3,4[e]	10500	CNCAR	15	16
Tetrachlorobenzene;1,2,3,5[e]	10500	CNCAR	210	300
Tetrachloroethene	2570	CCAR	0.022	ND
Thallium	245	CNCAR	0.9	9
Total Petroleum Hydrocarbons (TPH)	200	AGW	1000	1600
Trichlorobenzene;1,2,4	4590	CNCAR	140	63

Chemical Name	Industrial Soil Cleanup Level (mg/kg)	Method[a]	Maximum Concentration above 15 feet below ground surface[b]	Maximum Concentration Below 15 feet depth[b]
Trichloroethylene	11900 0.5	CCAR AGW	ND	1.485
Trichlorofluoromethane	1.05×10^6	CNCAR	ND	0.58
Xylene	7×10^6 20	CNCAR AGW	3.2	ND
Zinc	700000	CNCAR	950	2170

Footnotes to Table 2

(a)Level calculated according to the following:
CNCAR= WAC 173-340-745(4)(a)(iii)(A) equation value
CCAR = WAC 173-340-745(4)(a)(iii)(B) equation value
AGW = WAC 173-340-745(2)(a)(i) Table 3 Value, noted for ground water protection, derived from WAC 173-340-745(4)(a)(ii)(A)
ACAR = WAC 173-340-745(2)(a)(i) Table 3 Value, noted for direct contact protection

(b)Values taken from Phase IV Remedial Investigation (Bechtel, 1991) and Combined Feasibility Study (Bechtel, 1992), Table 1-3

(c)Reference dosage used in calculation assumes all material present is of highest toxicity for that substance

(d)No IRIS value currently assigned

(e)Reference dosage used in calculation based upon assumptions from Risk Assessment (Everest Consultants, 1992)

Table 3
Alternative Cleanup Concentrations for Ground Water

Chemical	Federal MCL	Federal MCLG for non-carcinogens	Secondary MCL	State MCL	Risk equation
Total PCBs	0.5 ug/l	N/A	N/A	N/A	0.0114 ug/l

Table 4
Alternative Cleanup Concentrations for Soil

Chemical	Federal Guidance	Level Based upon Ground Water Protection	MTCA Health Based Equation Value WAC 173-340-745(4)(a)(iii)(B)
Total PCBs	10 -25 mg/kg	60 mg/kg	17 mg/kg
Total Petroleum Hydrocarbons (TPH)	N/A	200 mg/kg	N/A

Table 5
Final Cleanup Levels and Site Risk

Media	Chemical	Cleanup Level	Basis	Risk
Surface Soil	PCB	10 mg/kg	WAC 173-340-745(2)(a)(i)	5.9×10^{-6}
Deep Soil	PCB	60 mg/kg	WAC 173-340-740(5)(b)	N/A
Soil	TPH	200 mg/kg	WAC 173-340-745(2)	N/A
Ground Water	PCB	0.1 ug/l	WAC 173-340-720(2)(a)(i)	1×10^{-6}
Total Site Risk				6.9×10^{-6}

Table 6
Proposed Cleanup Actions versus Threshold Criteria

Cleanup Action	Protect Human Health and the Environment	Comply with Cleanup Standards	Comply with Applicable State and Federal Laws	Provide for Compliance Monitoring
No Action	no	no	no	no
Off-site Disposal of Soil, and Institutional Controls on Ground Water Use	yes	yes	yes	yes
Dechlorination and In-Situ Stabilization of Soil, Extraction of Ground Water and Discharge to a POTW without Pretreatment	yes	yes	yes	yes
Vitrification of Soil and Institutional Controls on Ground Water	yes	yes	yes	yes
On-site Incineration of Soil, Extraction and Pretreatment of Ground Water by Filtration and Carbon Treatment, and Discharge to a POTW	yes	yes	yes	yes

Table 7
Combined Cleanup Actions and Cleanup Priorities

Cleanup Action	Reuse or Recycling	Destruction or Detoxification	Separation or volume reduction	Immobilization	On-site or off-site disposal at an engineered facility	Isolation or containment	Institutional Controls and monitoring
No Action	no	no	no	no	no	no	no
Off-site Disposal of Soil, and Institutional Controls on Ground Water Use	no	soil - no g/w - no	soil - yes g/w - no	soil - no g/w - no	soil - yes g/w - no	soil - no g/w - yes	soil - yes g/w - yes
Dechlorination and In-Situ Stabilization of Soil, Extraction of Ground Water and Discharge to a POTW without Pretreatment	no	soil - yes g/w - no	soil - yes g/w - no	soil - yes g/w - no	soil - no g/w - yes	soil - yes g/w - yes	soil - yes g/w - yes
Vitrification of Soil and Institutional Controls on Ground Water	no	soil - yes g/w - no	soil - yes g/w - no	soil - yes g/w - no	soil - no g/w - no	soil - yes g/w - yes	soil - yes g/w - yes
On-site Incineration of Soil, Extraction and Pretreatment of Ground Water by Filtration and Carbon Treatment, and Discharge to a POTW	no	soil - yes g/w - no	soil- yes g/w - no	soil - yes g/w - no	soil - no g/w - yes	soil - no g/w - yes	soil - yes g/w - yes

Table 8
Comparison of Cleanup Alternatives with Permanent Solution Criteria
WAC 173-340-360(5)

Cleanup Action	Media	Overall Protectiveness	Long Term Effectiveness	Short Term Effectiveness	Reduction in Toxicity, Mobility, and Volume	Implementability	Cost
Off-site Disposal of Soil, and Institutional Controls on Ground Water Use	Soil	high	moderate	moderate	low	high	low
	Ground Water	moderate	moderate	moderate	moderate	high	lown
Dechlorination and In-Situ Stabilization of Soil, Extraction of Ground Water and Discharge to a POTW without Pretreatment	Soil	high	high	high	high	moderate	low
	Ground Water	high	high	moderate	moderate	moderate	high
Vitrification of Soil and Institutional Controls on Ground Water	Soil	high	high	high	high	moderate	moderate
	Ground Water	moderate	moderate	moderate	moderate	high	low

Cleanup Action	Media	Overall Protectiveness	Long Term Effectiveness	Short Term Effectiveness	Reduction in Toxicity, Mobility, and Volume	Implementability	Cost
On-site Incineration of Soil, Extraction and Pretreatment of Ground Water by Filtration and Carbon Treatment, and Discharge to a POTW	Soil	high	high	moderate	high	moderate	high
	Ground Water	high	high	moderate	moderate	moderate	high

Table 9
Federal and State Laws and Regulations Applicable or Relevant and Appropriate to the Proposed and Contingent Cleanup Actions

ACTION	CITATION	COMMENT
Cleanup Action Construction	29 CFR 1910	Occupational Safety and Health Act
	Ch. 43.21 RCW; Ch. 197-11 WAC	State Environmental Policy Act and Rules
	Ch. 296-155 WAC	Safety Standards for Construction Work
	Ch. 296-62 WAC	Occupational Health Standards--Safety Standards for Carcinogens, Part P Hazardous Waste Operations and Emergency Response
	Ch. 173-340 WAC	Model Toxics Control Act Cleanup Regulation, defines administrative requirements for selecting and implementing cleanup actions
	Ch. 173-160 WAC	Minimum Standards for Construction and Maintenance of Wells
Cleanup Standards	Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act and Regulation

ACTION	CITATION	COMMENT
Soil Remediation	40 CFR Part 761	Toxic Substances Control Act; primary regulation affecting PCBs
	40 CFR Part 50	National Primary and Secondary Ambient Air Quality Standards
	40 CFR Part 264	Resource Conservation and Recovery Act
	Ch. 70.105 RCW; Ch. 173-303 WAC	Washington State Dangerous Waste Management Law and Regulation
	Ch. 70.95 RCW; Ch. 173-304 WAC	Washington State Solid Waste Management Law and Regulation
	Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act and Regulation
	Ch. 173-400 WAC	Washington State General Requirements for Air Pollution Sources
	Ch. 173-403 WAC	Implementation of Regulations for Air Contaminant Sources
	Ch. 173-470 WAC	Washington State Ambient Air Quality Standards for Particulates
	Ch. 174-50 WAC	Accreditation of Environmental Laboratories
	Ch. 173-216 WAC	Washington State Waste Discharge Permit Program

ACTION	CITATION	COMMENT
Ground Water	Ch. 90.48 RCW	Water Quality Laws of Washington
	Ch. 173-160 WAC	Minimum Standards for Construction and Maintenance of Wells
	40 CFR Part 141	National Primary Drinking Water Standards
	Ch. 70.105D RCW; Ch. 173-340 WAC	Model Toxics Control Act and Regulation
	Ch. 90.52 RCW	Pollution Disclosure Act
	Ch. 90.54 RCW	Water Resources Act of 1971
	Ch. 90.44 RCW	Washington Ground Water Laws
	Ch. 173-150 WAC	Protection of Withdrawal Facilities Associated with Ground Water Rights
	Ch. 173-154 WAC	Protection of Upper Aquifer Zones
	Ch. 173-216 WAC	State Waste Discharge Permit Program

Appendix A
PCB Concentrations Protective of Ground Water
GE/Spokane Site

Concentrations of chemicals which remain at sites must minimize the potential for cross media contamination. At the GE/Spokane site, on-site soils must be at levels protective of current or future beneficial uses of ground water [WAC 173-340-700(7)(h)] consistent with the reasonable maximum exposure scenario for that ground water.

As the reasonable maximum exposure to ground water at this site is through drinking water, a soil concentration must not violate the Method B cleanup level for ground water.

Determination of levels protective of ground water requires modeling, unless the soil concentration is set equal to 100 times the ground water concentration [WAC 173-340-745(4)(a)(ii)(A)]. Ecology has applied a model to determine this concentration.

A model must consider the three phases in the system: the soil; the water contained within the soil, and the saturated aquifer water. Transport of contaminants from soil to ground water requires the contaminant to travel from the soil to the water in the soil, and then transport of that water to the aquifer, where it can be detected.

A conservative model presumes that the soil is nearly saturated with pore water, and that this pore water need not travel a great distance to the aquifer. Thus, the calculation must first determine what concentration in soil pore water will yield a concentration in the aquifer equal to the cleanup level. Secondly, the soil concentration in equilibrium with this pore water must be determined, and finally, a concentration representing the bulk analysis likely to be found in a sample can be predicted.

The mass of contaminant which will generate a violation of the ground water cleanup level is dependent upon the volume of potentially contaminated water, and on the volume of water in the aquifer.

One equation to model this relationship is (USDOE, 1991):

$$C_{pw}=C_{gw}\cdot\frac{JKM_d+LI}{LI}$$

In this equation, values are:

C_{pw} is the pore water concentration;

C_{gw} is the cleanup level for ground water = 0.0114 ug/l;

J = the Hydraulic Gradient = 1.3×10^{-3} m/m (Average gradient well MW-1 to MW-11, Phase V RI);

K = the Hydraulic Conductivity =9.14×10^{-3} m/sec =288,239 m/yr (Phase V RI);

Md = the Mixing zone Depth = effective depth of monitoring well screen, roughly 3 meters

L = the cross section width of the vadose zone plume = 5.1 m (Phase IV RI, plume width at 15 feet depth); and

I = the infiltration rate = Rainfall - Evapotranspiration = 4.6 in/yr = 0.1164 m/yr (Phase V RI)

The concentration of pore water entering the aquifer resulting in a concentration equal to the ground water cleanup level is then:

$$C_{pw} = 0.0114 \text{ ug/l} \frac{[(1.3 \times 10^{-3} \text{ m/m} \times 288239 \text{ m/yr} \times 3 \text{ m} + 5.1 \text{ m}(0.1164\text{m/yr})]}{[5.1\text{m } (0.1164 \text{ m/yr})]}$$

C_{pw} = 21.60 ug/l = 0.0216 ug/ml

To calculate the concentration in soil that is in equilibrium with this pore water, we use the soil/water distribution coefficient (K_d) for the site. This partition coefficient for organic chemicals, in this case PCBs, is largely dependent upon the fraction of organic carbon (f_{oc}) present at the site. Organic chemicals are attracted and sorbed to organic carbon in soils, and are thus unavailable for transport in aqueous solution. K_d is related to f_{oc} by the equation:

$$K_d = f_{oc} \cdot K_{oc}$$

Where K_{oc} is the organic carbon/water partition coefficient. K_{oc} is generally specific for individual chemicals and experimentally derived. For the PCBs at this site, this number is very large reflecting the large attraction for PCBs to organic matter. At this site, log K_{oc} based upon a dominant PCB content of Aroclor 1260 is 5.61 (Everest, 1992).

The fraction organic carbon value was determined to be 0.68% at this site (Bechtel, 1992). Thus,

$$K_d = (0.0068) \times (4.074 \times 10^5)$$

$$K_d = 2770$$

The soil water partition coefficent then defines the equilibrium concentrations of PCB on soil and water by the relationship:

$$K_d = \frac{C_s}{C_{pw}}$$

where

C_s = the ug of PCB absorbed on soil / g of soil

C_{pw} = ug/ml of PCB in pore water = 0.0216 ug/ml

or

$$2770 = \frac{C_s}{0.0216 \text{ ug/ml}}$$

Soil Concentration = C_s = 59.83 ug/g

This is equal to a concentration of 59.83 mg/kg, or parts per million.

The concentration determined from an analysis of bulk soil, then, is the sum of the material analysed. This includes the concentration in soil, plus the concentration in water corrected for volume.

This can be expressed as

$$C_b = C_s + C_{gw} \cdot \frac{\theta}{\rho}$$

Where :

C_b = The desired value from analysis of soil cuttings

C_s = The soil concentration = 59.83 mg/kg

C_{pw} = The pore water concentration = 0.0216 mg/l

θ = The volumetric water content = the porosity at saturation

$= .25$

ρ = The density of the material = 2.54 g/cm^3

The correction becomes, then,

$$C_b = 59.83 + .0216(.25/2.54)$$

$$C_b = 59.832$$

For all intents and purposes, within the bounds of analytical precision, and in consideration of rounding and estimates used in the calculation, the concentration of PCBs in soil expected to be protective of ground water is 60 mg/kg.